THE IMPACT OF AGRICULTURAL CHANGES ON THE RURAL LANDSCAPE OF SOUTH EAST SCOTLAND, 1972 - 1990

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Declaration

I, Abdul Ghaffar, hereby declare that the work present herein is my own and not presented before in any other university, and that this thesis was composed by me.

Abdul Ghaffar

Abstract

This study investigates the impact of agricultural changes on the rural landscape of South East Scotland, focusing upon the period between 1972 and 1990 under the Common Agricultural Policy (CAP) of the European Community (EC).

Agricultural Returns are used to examine agricultural change at parish level and an integrated analysis of Ordnance Survey maps, aerial photographs and interpretation via GIS is used to investigate the rural landscape change in two sample areas (one in East Lothian and the second in Berwickshire). Great changes in agricultural holdings, average farm size and in land tenure have occurred in South East Scotland reflecting the effects of the CAP policies. Major agricultural changes, due to the price support policy, are found in the area under wheat, oilseed rape, oats, dairy cattle and sheep production whereas remaining crops and livestock showed no significant changes. The area under farm woodland has increased.

The sample areas show major differences in the process of landscape change. Field boundaries have been removed to enlarge fields. Hedgerows and post & wire fence boundaries have been the main focus of removal. Hedgerow boundaries have been re-planted in the sample areas mostly replacing post & wire boundaries. The major removals have occurred in areas best suited for crop production but re-plantation has occurred in all parts of the sample areas. Other farm features have insignificant changes in sample areas.

Farmers have intensified agricultural production focusing upon wheat, oilseed rape, beef cattle and sheep production. The increase of field drainage has been a major activity on the farms to increase the farm productivity. Field boundaries especially hedgerows and post & wire have been removed to increase the farm and field size. Later, hedgerow boundary has been re-planted particularly replacing post & wire boundary. The Farm Capital Grant Schemes (AHDS, FHDS, AIS, FGS, and CGS) and the Farm Woodland Scheme have been a major point in farmers' participation. The price support policy has been favoured by the farmers and the reforms in price support policy and structural policies are disliked by the farmers.

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List of abbreviations

AIS	Agriculture Improvement Scheme
AHDS	Agriculture and Horticulture Development Scheme
ALURE	Alternative Land Use and the Rural Economy
BAE	Board of Agricultural Economics
CAP	Common Agricultural Policy
CC	Countryside Commission
CCS	Countryside Commission for Scotland
CEC	Commission of the European Community
DAFS	Department of Agriculture and Food for Scotland
EC	European Community
ESAs	Environmental Sensitive Areas
FDGS	Farm Diversification Grant Scheme
FWS	Farm Woodland Scheme
FCGS	Farm and Conservation Grant Scheme
FHDS	Farm and Horticulture Development Scheme
FEOGA	European Guidance and Guarantee Fund
GATT	General Agreement on Tariffs and Trade
GIS	Geographic Information System
HMSO	Her Majesty's Stationery Office
LFAs	Less Favoured Areas
MAFF	Ministry of Agriculture, Food and Fisheries
MLURI	Macaulay Land Use Research Institute
NCC	Nature Conservancy Council
NSAs	Nitrate Sensitive Areas
OS	Ordnance Survey
PMBS	Potato Marketing Board for Scotland
RCAHMS	Royal Commission on Ancient and Historical Monuments of Scotland
SAC	Scottish Agricultural College
SES	South East Scotland
SAS	Set Aside Scheme
smd	standardized man-day
sgm	standard gross margin
UK	United Kingdom
VAT	Value Added Tax

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

This study investigates the impact of agricultural changes on the rural landscape of South East Scotland in the period between 1972 and 1990, with reference to the Common Agricultural Policy (CAP) of the European Community (EC).

In the past, agricultural activity has been principally controlled by the physiography of the particular area. Since industrialisation of agriculture has taken place, the importance of physical factors has been overtaken by socio-economic and political factors. The pattern of these changes has been discussed, for example, by Bowler (1975b, 1979, 1981); Briggs (1989); Coppock (1968); Clark (1979, 1984, 1991); Gilg (1991); Greenshield and Bellamy (1989); Grigg (1982), Ilbery (1978, 1983b, 1985); Robinson (1988) and Munton et al. (1992). Under various political circumstances, the state has become one of the most important factors shaping both the structure of farming and the location of agricultural production (see Bowler, 1979, 1985; Bowler and Ilbery, 1987 and Tarrant, 1992).

1.2 BACKGROUND

Before 1973, the United Kingdom (UK) had its own agricultural policy to achieve the goals set out under the Agricultural Act 1947 (see Holderness, 1985 and Robinson, 1988). Since 1973, when the UK joined the EC , the CAP of the EC has been implemented in the UK. A fundamental objective of Article 39 of Treaty of Rome was the desire to raise the standard of living of the rural population of the member states. To achieve this objective, the CAP has used structural and price support policies. Comprehensive examination of the structure and policies of the CAP has been carried out by Bowler (1985), Fennel (1979); Hill (1984) and Marsh and Swanney (1980). Their work has suggested that the CAP has provided substantial support to farmers for the production of certain crops and livestock products. This support has been represented in a price guarantee system which has accounted for 95 per cent of the CAP budget (Robinson, 1991b), a system which symbolises the policy makers' pre-occupation with the pricing and marketing of agricultural products. Major agricultural changes have occurred in the UK since 1973 under the CAP (Robinson, 1988). These changes have affected the full range of agricultural activities, from changes in cropping patterns and land use to farm size structures, the nature of agricultural production, and the socio-economic conditions of farmers. The major impact has been upon overall production. For example, during the 1970s, cereal output in Britain rose by 24 per cent while the sales of milk off farms increased by 33 percent (Robinson, 1988). A range of work - Bowler (1976a, 1985, 1987); Bureau of Agricultural Economics (BAE) (1985); Downs (1991); Gaskell and Tanner (1991); Harvey (1990); Ilbery (1990); Jones (1989) and Wathern et al. (1988) - has discussed and evaluated agricultural conditions under the CAP, emphasising the trends and patterns of agricultural change.

These agricultural changes have determined changes in other ways in land used for agriculture (e.g. in the rural landscape, environment, and wild life). Soper and Carter (1985) have examined the effects of agricultural intensification upon the ecology and wildlife of the UK. The consequences upon the environment have also been analysed by Goodman and Redclift (1991); Green (1986); Lambert (1990); O'Riordan (1987); Potter (1986, 1988) and Robinson (1991a, 1991b).

One of the major consequences of the CAP has been the modification of the rural landscape (Blunden and Curry, 1985, 1988; Blunden and Turner, 1985; Newby 1988; Shoard 1980, 1987). The process of rural landscape change started before the advent of CAP, however, as Blunden and Turner (1985: 25) state: "On the agricultural land itself, the twentieth century has seen the dramatic impact of sophisticated and powerful machinery. Such machines have particularly encouraged a change, from a field size which was appropriate in an age of ox and horse power, to much bigger units of land". Farming practices under the CAP have substantially altered components of the rural landscape such as hedgerows, hedgerow trees, woodland, areas of rough grazing, downs, moors and wetlands. The use of machines has prompted field enlargement and the removal of obstructions in the form of hedgerows and stone walls. In addition, there has been the introduction of new farm buildings for machinery, feed, animals and dairy farms. Bowers and Cheshire (1983) noted, for example, a decrease of 35.5% in the length of hedgerows between 1947 and 1976 (a total decline of 1.2% p.a.), and a total which fell by a further 10.9% from 1976 to 1981 (about 2% per annum). Typical of the changes has been the decline in extent of the acid heaths in the Breckland of eastern England, which has been reduced in area by 87% in the last 50 years (Briggs and Courteny, 1985). Similar areas in Dorset, which covered 40,000 ha in 1759, had been reduced to 6,000 ha by 1978 (Webb and Hoskins, 1980).

A number of efforts have been made to investigate agricultural landscape change during the early 1970s both by individuals (for example, Brandon (1975); Emery (1974); and Pollard (1974); local authorities (Hereford and Worcester County Council, 1976), and government agencies (Countryside Commission, 1983; 1986). Most of the landscape studies which were carried out examined the period from 1945 to the early 1970s.

Under the Common Agricultural Policy (CAP) of the European Community, there has been growing concern in Britain about the impact of agricultural intensification on the British rural landscape, a landscape seen as integral to notions of nature and nation in Britain (Daniels, 1994; Thomas, 1984). The removal of field boundaries and especially hedgerows has been one of the major characteristics of agricultural intensification, and one most widely criticised. Shoard (1980), citing several examples, stated that about 120,000 miles in all or 4500 miles a year of hedgerows were removed in England and Wales between 1946 and 1974. In 1978 alone, 74 miles of hedgerows in England and Wales were grubbed out in the course of preparation for new drainage schemes to stop tree roots fouling new drains. There was a loss of 1087 miles of hedgerows in Worcestershire between 1900 and 1976 and in Herefordshire farmers removed an estimated 3730 miles during the same period and, in Norfolk, 8000 miles were removed between 1946 and 1970. In Grampian region (Scotland), it was estimated that about 6000 km hedgerows were removed between 1940s and 1970s (CCS and NCC, 1989). Apart from the removal of hedgerows and woodland, other farm features have been removed either for intensification of agriculture, field amalgamation or for establishment of new features such as woodland and farm buildings.

The removal of woodlands has also been subject to criticism along with other rural landscape features. Essex (1987) emphasised that agricultural intensification is a cause of neglect of woodland as farmers' time is diverted to other more profitable agricultural enterprises. He stated that in Nottinghamshire between 1920 and 1980 over one-half of the area of woodland loss was due to agricultural activities. However, the new area of woodland was double that of the woodland lost since 1920.

Most geographers and others have criticised intensification of agriculture for its destructive role in rural landscape change. Westmacott (1984) concluded, however, that the rate of change in lowland agricultural landscape has slowed significantly since 1972. Especially in those areas which have already experienced extensive changes, the pace is slower partly because there is little left which requires removal or alteration from the agricultural point of view. In those areas which have not experienced massive agricultural development, changes are tending to occur on a piecemeal basis. Westmacott noted that woodland has shown a small increase generally. In a study of Grampian region between the 1940s and the 1970s, it was estimated that there had been a loss of one-third of all broad-leaved woodland but a four-fold increase of acreage under conifers (CCS and NCC, 1989). In a recent study carried out by the Macaulay Land Use Research Institute (MLURI) in the central lowlands of Scotland, it was estimated that there had been a three-fold increase in the area of woodland cover from 1946 to 1988. The increase was largely due to the establishment of coniferous plantations. The area increased 6.1 sq. km from 1946 to 1970 and 58.6 sq. km from 1970 to 1988. On the other hand, the area of broad-leaved and mixed woodland had decreased from 31.2 sq. km in 1946 to 24.4 sq. km in 1988 (MLURI, 1992). Throughout the mid-1980s, when the problems of huge surpluses of agricultural production due to intensification and specialisation were particularly felt, a number of measures were introduced to control and curb this intensification and concentration. Blunden and Curry (1988, 25) record that "In addition to general encouragements, the Agricultural Improvement Scheme was introduced in 1985 with specific help for conservation measures. Under this scheme for the first time, farmers and particularly medium sized farmers, may be eligible for grant aid for investment in environmental improvement measures and for pollution prevention measures, for planting hedges and shelter belts, building dry stone walls and for constructing footbridges and styles".

Two major views are apparent in the above-mentioned studies. First, there is the claim that there has been removal of hedgerows and woodland due to the intensification of agriculture (Blunden and Turner, 1985; Shoard, 1980, 1987; Munton et al 1987 and Newby, 1988). Second, the view has been advanced that change in the rural landscape is occurring via a slow and uneven rate of change (Westmacott, 1984), or by re-plantation of hedgerows under schemes offered by the government (Blunden and Curry 1988), and through an increase under the area of woodland (MLURI, 1992). Westmacott (1984) has emphasised the slow rate of rural landscape change but supported the view that damage has been inflicted upon the rural landscape. Blunden and Turner claim that government schemes have been helpful in improving the rural landscape but their view is not based on detailed study of any sample area. MLURI (1992) did not investigate the rural landscape features which are an integral part of the rural landscape, such as hedgerows and other farm features. There is, therefore, a real need to investigate the patterns of change in rural landscape based on a more defined sample area so that change can be viewed on the basis of agriculture, rural landscape and more detailed field survey.

1.3 OBJECTIVES

The aim of this study is to examine the nature of rural landscape change in relation to agricultural change under the CAP. Earlier studies of rural landscape change have been principally carried out in England. This study considers South East Scotland, the most fertile agricultural region of Scotland.

The first objective of this research is to investigate the effects of agricultural change on the rural landscape of South East Scotland focusing upon removal of hedgerows, hedgerow trees, creation of and uprooting of ditches, ponds, changes in field size, post and wire fences, farm buildings, woodland and other landscape features associated with agricultural land.

The second objective of this research is to investigate agricultural change in the area as a result of the CAP, which may be presumed to have played an important role in altering the rural landscape. This examination will discuss changes in connection with those CAP price support and structural policies which have been implemented either to attain self-sufficiency or to encourage farmers to extensify and diversify their agricultural activities since 1973.

The third objective is to explore the responses of farmers towards the CAP. How did they feel about the policies of the CAP ? To what extent have they opted for particular policies ? What agricultural and landscape changes have occurred on their farms ? What were their responses to the price support and structural policies ? What were their responses towards the reforms of the CAP ? Importantly, there is a need to know how farmer responses have been made apparent in changes in the rural landscape.

1.4 STUDY AREA

The study area (South East Scotland) consists of Fife, Lothian and Borders regions comprising 11 administrative districts and 199 civil parishes. Two sample areas in the study area, one in East Lothian and one in Berwickshire, were selected for detailed investigation of rural landscape change. The methodology for choosing the study areas is explained in chapter 3. Figure 1.1 represents the study area with civil parishes and sample areas for landscape change.

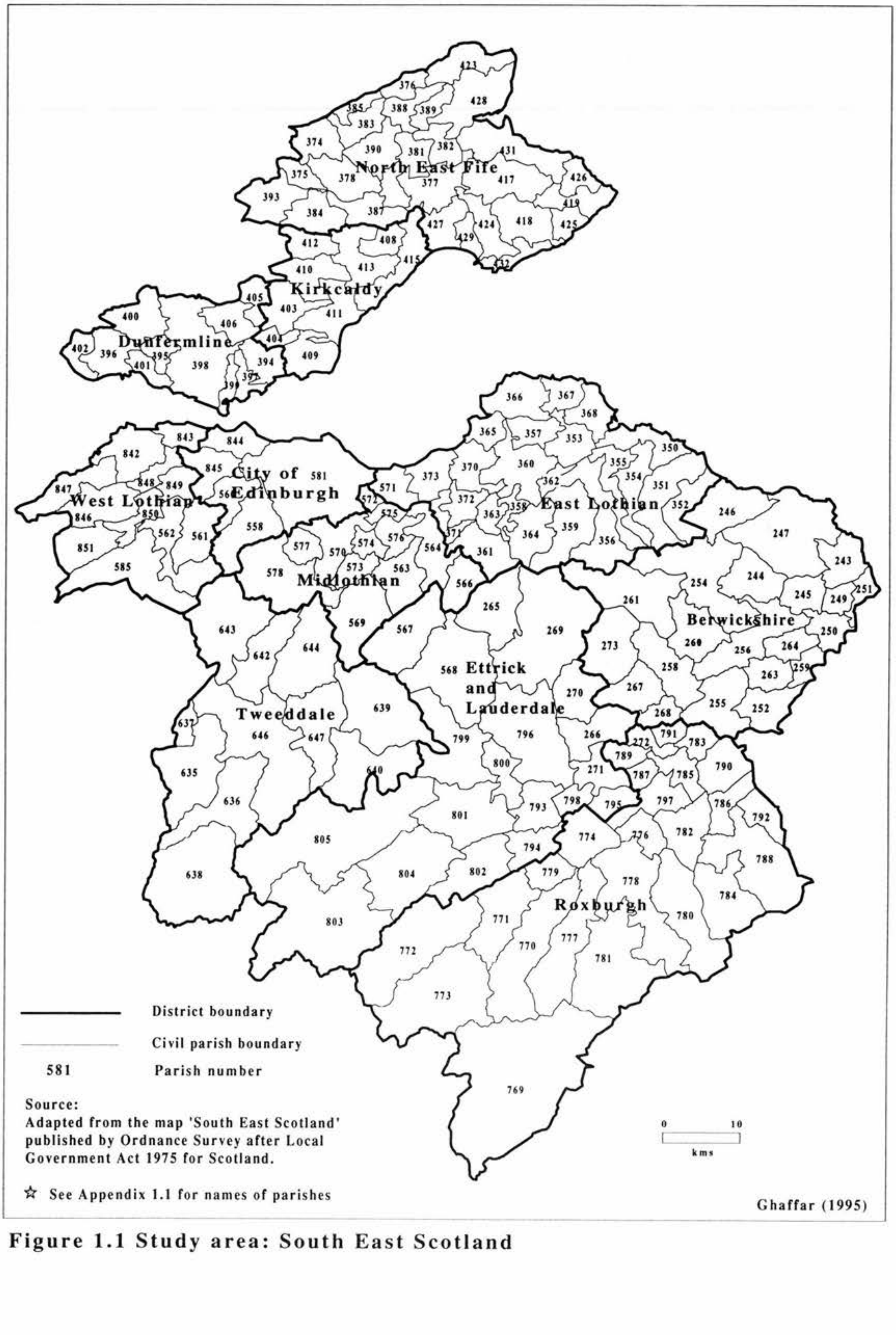


Figure 1.1 Study area: South East Scotland

1.4.1 Topography and physical regions

For any region, the nature of the terrain, type of rocks, geological land structure, drainage systems, soils, altitude and climate along with social, economic and political factors all affect the nature and production of agricultural activity.

Figure 1.2 describes the topography and physical regions of South East Scotland. South East Scotland is divided into the Central Lowlands and Southern Uplands. The whole of the Central Lowlands except for the Ochil Hills, the Pentland Hills and most of East Lothian consists of shales with hard sandstone and some massive limestone. These are mixed carboniferous rocks which generally have low resistance to erosion. Most parts of the high ground in the Central Lowlands, like the Ochils and the Pentlands comprises nearly horizontal layers of basaltic rocks (Lea et al, 1977). These extrusive igneous rocks of basalt or andesite type are more limited in distribution, occurring mainly in the Central Lowlands. The whole of Fife and major parts of Lothian region and Berwickshire district are below 150 metres above sea level. The eastern uplands near the coast are generally under 300 metres. Most parts of the uplands, except the central part which is highly rugged between 600 to 750 metres, are moderately rugged having a height between of 300 to 600 metres. The landscape is extremely dissected, especially in the west, with low-lying valleys winding and interconnecting between steeply sloping often precipitous upland terrain. Drainage in Fife is carried out by the Eden and Ore rivers and their tributaries. In Lothian, the river Tyne and its tributary burns supply East Lothian's fertile arable land. The Tweed, Black Adder and White Adder, Gala Water and a number of burns drain the Southern Uplands.

Fife is bounded on the north by the Ochils. The south-western side is formed by the slopes of the Lomond Hills which curve to the south forming a tongue of lowland running between the Lomonds and the higher ground of the East Neuk. To the south of the Lomonds, west of the hills of the East Neuk, lies the central plain of Fife, the Howe of Fife. South-west Fife is mostly a plateau with a well-marked grain east-north-east to west-south-west.

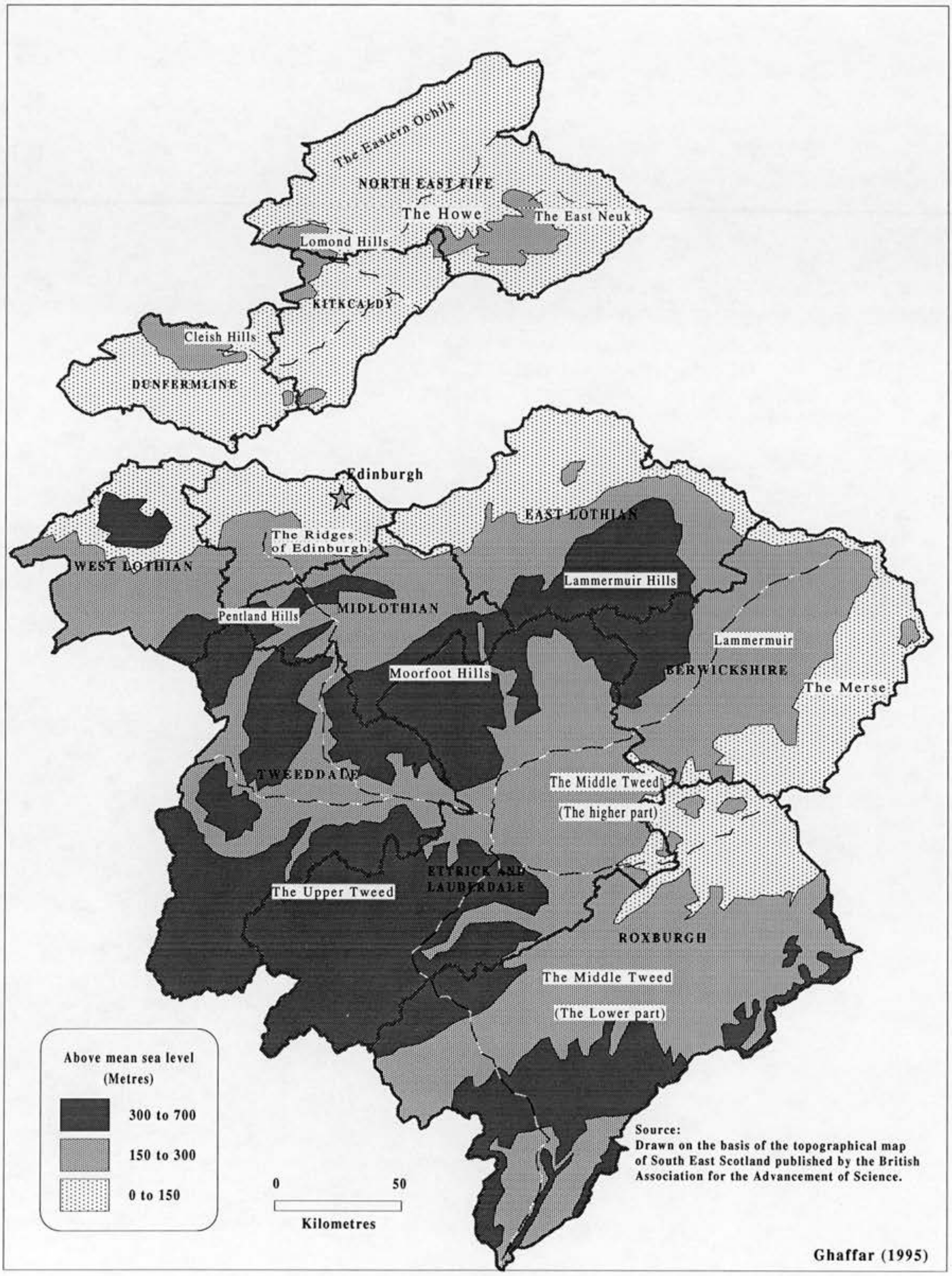


Figure 1.2 Topography and physical regions of South East Scotland

The Lowlands (all that part of Lothian not included under the headings 'Lammermuir and Moorfoot Hills' and 'the Pentlands') includes the Bathgate Hills and the high bleak uplands of the West Calder and Whiteburn districts, both of which are around 300 metres above mean sea level. The elevated mass of the Pentland Hills extends for some 25 kms from north-east to south-west and 5 to 9 kms from north-west to south-east. The Lammermuir and Moorfoot hills form the north eastern extremity of the Southern Uplands. To the north-west the hills are truncated by the southern upland fault while to the south and south-east they gradually merge into the Tweed region. In the north east the Dunbar-Oldhamstocks fault cuts off the Lammermuirs from the sea though the intervening lowlands are only 2 to 5 kms. in width.

Tweedside is a region of hills and valley slopes. The northern side has a valley floor at about 360 to 400 metres above mean sea level which has been dissected to give a series of long spurs cut off by rising ground. To the south of Lammermuirs is the Merse lowland situated between the middle and lower Tweed. It includes some uplands. The Tweed basin, Lammermuir, and the Merse are the prominent features of the eastern Southern Uplands. Apart from these higher prominent features, the whole Borders region has a rugged relief with hills, valleys, streams, steep slopes and lower plateaux. The high plateaux of Manor Hartfell plateau, Ettrick-pen plateau, Culter Fells and Leithen plateau are formed by the deep dissection of an old mature surface surmounted by low and subdued residual eminencies and subsequent glacial modification of already deep valleys. The Upper Tweed is an area of glacially-modified valley summits. Ridges are long and continuous with undulating crests. The south-west portion offers some transition to the high plateau. The Upper Gala region is formed by fully matured dissection followed by incision of the Gala, Lugate, Heriot and Arnet Waters. Hills are rounded and subdued, with summits 366-472 m, and slopes above 305 m level are always gentle (Stamp, 1940, 1960; Watson, 1964).

1.4.2 Soil

"The distinctive features of Scottish soils are their youth and their generally low level of natural fertility. They have been formed since the retreat of the Pleistocene ice sheets some 10,000 years ago and are mainly derived from drift deposits which in turn are largely the products of acid rocks" (Coppock, 1976b: 12). Figure 1.3 shows 64 major and 270 sub-types of soil of the overall study area according to the Soil Survey of Scotland (for details see MLURI, 1982). The soils of the lowlands are derived from three main sources of parent material: (a) boulder clay (b) glacial and marine, sands and gravels (c) alluvium.

Among the most fertile soils of Fife are those lying on the 40m beach from St. Andrews to Largo , where a deep rich loam is found. On the coastal strip from Leven to Inverkeithing, the soils vary from light dry to rich clayey loam, the most fertile districts being the alluvium area of Leven, the raised terrace near Kirkcaldy, and the patches of igneous soils in the Burntisland district. The coast of the upper Firth between Dunfermline and Culross is very fertile, since the soil is derived from an igneous outcrop. The Ore valley and the high lands near Dunfermline are covered with a subsoil of boulder clay over which sometimes lies a thin loam. The Howe of Fife as far inland as Cupar is very fertile. The soil is cold and stiff and clayey mixed with lime. Along the southern slopes of Forgan and Ferry Port on Craig, the soil, though light and variable, is very suitable for farming. The soils produced over these mixed sands and clays of the older marine deposits are generally good loam.

Boulder clay soils are by far the most extensive and varied ranging from very heavy clays to light sands. Soils derived from boulder clay of coal measures origin are inclined to be heavy clays, often black in colour and difficult to work. In the lowlands west of the Pentlands the crushed shales of this series yield clays not dissimilar to those from the coal measures, but in the Haddington-Morham-Bolton districts they are represented by a stiff yellow infertile clay which, at the present day, is largely under wood and meadows. On the other hand, the drift in the East Lothian promontory consists of a mixture of crushed limestone shales, basic igneous material and stone largely of local origin which yield very rich soils and are not difficult to

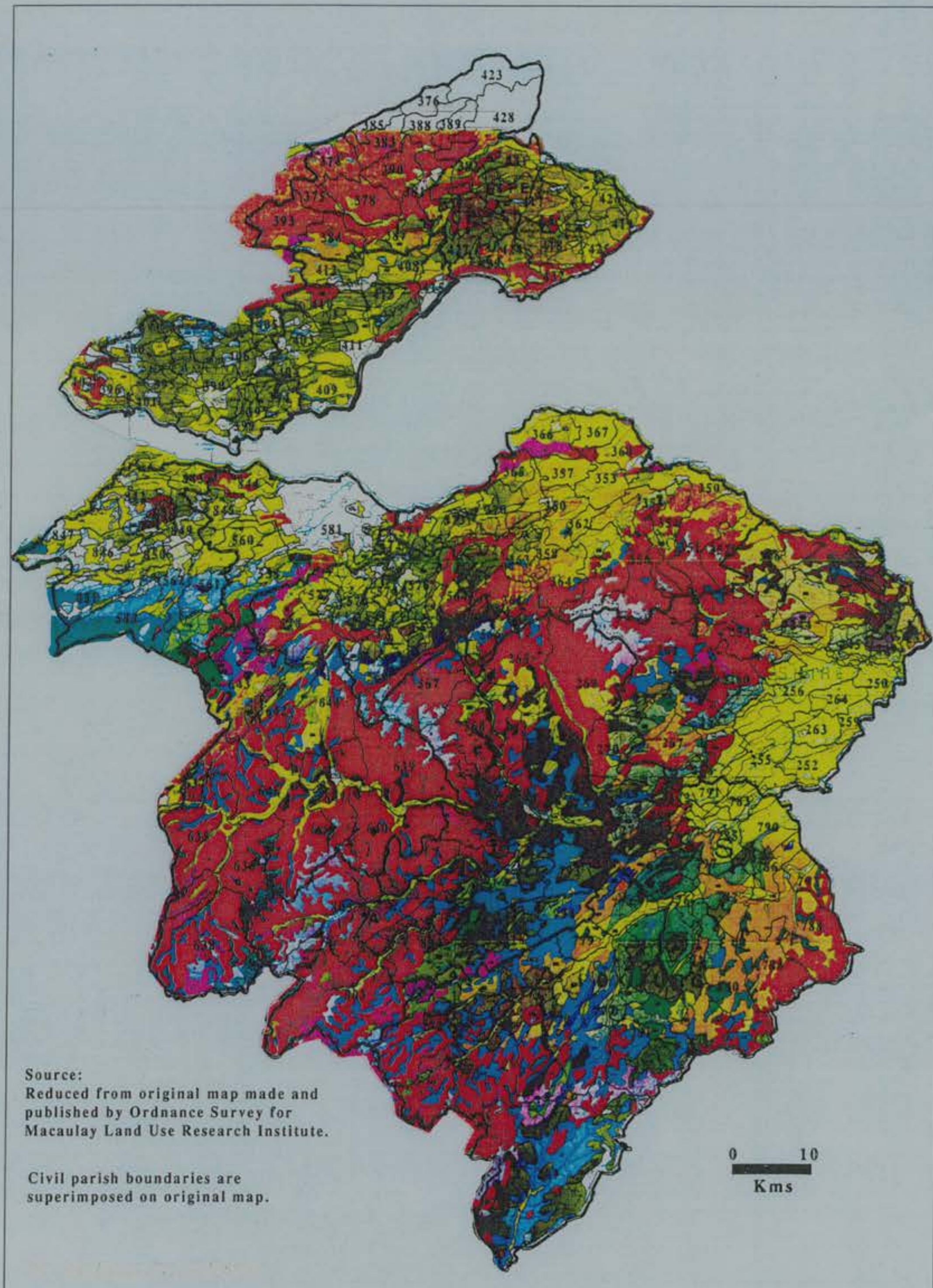


Figure 1.3 Soil types in South East Scotland

work. The richest soils in the Lothians are those derived from the coastal sands and gravels in the neighbourhood of Dunbar.

In Berwick drift cover covers almost all the surface. Deep loam is the type of soil found on the riverside of the large streams such as the Tweed, Blackadder and Whiteadder. The soil is fertile and deep. The Merse commonly has clay in the soil. It is black in colour, deep and fertile. The moraines of the upland valleys are almost strongly podsolised. The light textured drift soil of the valley floors and lower terraces are, in fact, the core of the region. On the areas of greywackes, the soils are generally cold, wet grey clays, but these when mixed with other material and well drained and sheltered, give good grain crops. Over the volcanic rocks there is a generally loose, light warm sandy loam. Near the rivers, a deep, rich, strong loam is commonly found (MLURI, 1982).

1.4.3 Climate

"Climate is the most important physical factor affecting agricultural activity in Scotland, although it is itself much modified by the range of relief and the disposition of landforms by proximity to relatively warm seas and by the deep interpenetration of land and sea" (Coppock, 1976b: 14). Figure 1.4 presents the climate and distribution of rainfall in South East Scotland. Lea et al (1977: 38) divide South East Scotland into three climatic regions. The North Sea Coast Lowland-type region comprises the north and north-east coast of Lothian and Borders region. The characteristics of this region are low rainfall, generally below 750 mm per annum, with more falling in summer than winter. The winters are cool but there are less than 50 days per annum with air frost and less than 15 mornings with snow lying. The region is rather exposed, with a moderate incidence of strong winds, and a high incidence of sea mist. The Eastern Lowland Lowland-type region covers the whole of the lowlands of Lothian and Fife regions. It is characterised by low rainfall, generally below 750 mm per annum, more falling in summer than winter. It is also wetter with cold winters, more than 15 days per annum with air frost and warmer summers, and is generally sheltered with a low incidence of strong winds. The Southern Upland Upland-type region covers the whole of the Borders region or Southern Uplands.

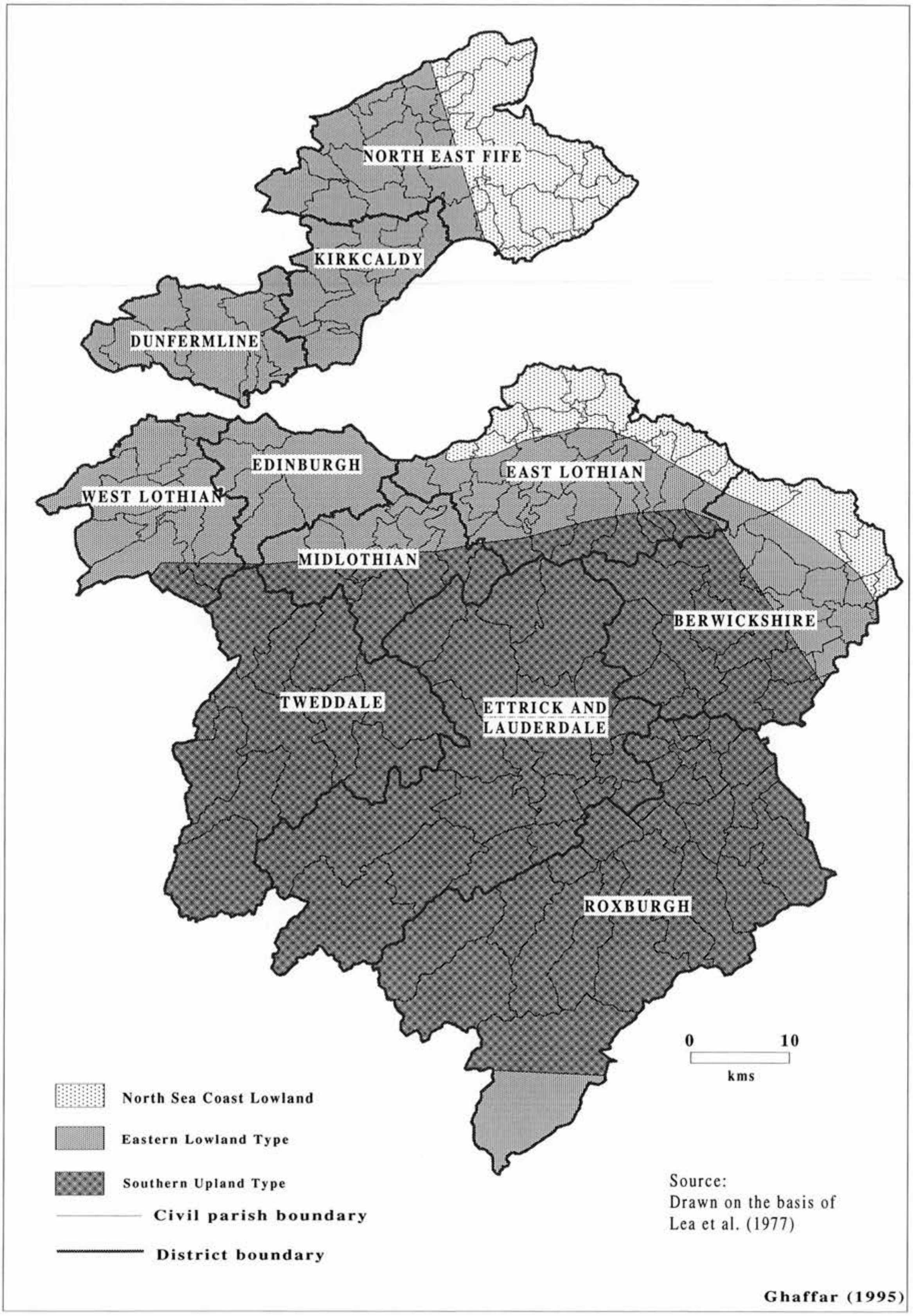


Figure 1.4 Climatic regions of South East Scotland

Its characteristics are moderate rainfall (generally between 1000 and 1500 mm per annum), generally very cold and drier in winter and warmer in summer.

There are two main factors affecting the distribution of rainfall, elevation and location. Rainfall throughout the area generally increases with altitude and decreases from west to east. This phenomenon is due to the eastern districts lesser exposure to the prevailing westerly and south-westerly rain-bearing winds. Rainfall is generally moderate, being below 600 mm along the coast of East Lothian and parts of the Fife coast. It is less than 800 mm over most of the East Lothian plain and in the Howe of Fife, a circumstance of great advantage in the production of grain and root crops on these fertile lands. Rainfall is uniformly distributed over the year but during the easterlies in spring it is often limited. So spring is often a period of slow growth. August is usually the wettest month. Rainfall is, of course, much greater in the hills, rising to over 1000 mm on the Fife hills and eastern Lammermuirs and to over 1200 mm on the Ochils above Kinross and in the exposed western Lammermuirs.

The whole of eastern Fife is very favoured as regards sunshine. The mean daily sunshine for the whole year is between 3.5 and 4.0 hours. June is the sunniest month and December is dullest. June has a daily average of sunshine exceeding 6.5 hours on the coast and between 6.0 and 6.5 hours inland whereas December has an average of only about one hour over the whole region. In winter the shores of the Firth of the Forth and the coastal strip southwards have temperatures of over 4.5 degree C. In summer the coast from Fifeness to the mouth of the Tay has a temperature below 14.5 degrees C. and the rest of the area above 14.5 degrees C. January is the coldest month with a mean, slightly under 3.9 degrees C. and July with 15 degrees C. the warmest. May and October are the months whose mean temperatures are nearest to the mean for the whole year.

The westerlies along the Forth makes shelter belts necessary on the East Lothian plain but have some influence in reducing the number of ground-frosts in coastal areas. Dunbar is particularly favoured in this respect with an annual average of just over 60 nights with frost, usually confined to the period between November and April. In the sheltered areas and valleys, ground frost is liable to occur on clear quiet nights following cool days at any time between September and May and occasionally in June and August. Since snow is almost invariably brought by winds between north and east, falls are greatest in the eastern parts of the Lammermuirs. Along the coasts snow falls on average about 15 days per year but lies on only about five days. On the highest Lammermuir tops, it lies for about seventy-five days per year. Thunderstorms rarely occur outside the summer months. The very occasional winter thunderstorm is usually frontal and comes from the west. During the short sea passage the air is so cooled at the surface that fog may develop.

1.5 SUMMARY

This chapter has explained the nature of this project. Although a number of authors (Blunden and Curry, 1985; Shoard, 1980; Munton et al, 1987 and others) have been anxious to study agricultural conditions under the CAP and the effects of its policies upon the inter-related phenomena of agriculture (for example, ecology and wildlife, environment and landscape), only limited attention has been paid to investigate rural landscape change resulting from CAP policies. Most of the studies have focused on England (Countryside Commission, 1983; Bower, 1983 and Westmacott,1984). Only a few studies have been carried out in Scotland (CCS and NCC, 1989 and Barr et al. 1986). The latest study by MLURI (1992) was carried out to investigate land cover change. There is then, a need to carry out an investigation in Scotland during the period under the CAP. This study will explore levels of agricultural intensification and its impact on the rural landscape. It will also investigate farmers' responses towards the CAP policies during the period under the CAP.

One of the objectives of this study is to investigate agricultural change in the area since it is the determinant of rural landscape change. Before proceeding to examine agricultural change in detail, it is necessary to evaluate the factors playing an important role in the changing patterns of agriculture. This is the theme of the following chapter.

CHAPTER 2

FACTORS OF AGRICULTURAL CHANGE

2.1 INTRODUCTION

This chapter examines and summarises those studies which have investigated the factors behind the geography of agricultural change. A number of geographers (e.g. Bowler, 1992; Clark, 1979, 1982, 1984; Gilg, 1985; Grigg, 1984; Ilbery, 1985; Robinson, 1988; Pacione, 1984, 1986) have written about agricultural geography and reports in 'Progress in Human Geography' (Grigg, 1981, 1982, 1983; Bowler, 1984, 1985, 1986, 1987, 1988, 1990; Whatmore, 1991a) have discussed the changing trends in agricultural geography. Agricultural geographers have also reviewed different approaches to the study of agricultural activity (e.g. Clark, 1991; Ilbery, 1985 and Tarrant, 1974).

Robinson (1988) has argued that agricultural geographers have focused upon topics with close parallels within agricultural history where, practically, the study of agricultural change depends upon the sources available: for example, the Tithe Survey (e.g. Kain, 1986), the 1801 Crop Returns (e.g. Thomson, 1963), and farm and estate records (e.g. Grigg, 1966; Thirsk, 1957). Several studies have focused on the nature of changing land use over time (e.g. Bowler, 1981a; Harvey, 1963; Muth, 1961; Perry, 1975). Parry (1972a) amongst others has emphasised the role played by the individual in agricultural change. Studies of improved farming techniques have emphasised personalities and the work of individuals (e.g. Fussell, 1966), whilst studies of changes in land use have often been tied closely to innovators who pioneered the changes (e.g. Emery, 1976; Kerridge, 1967). More broadly, the investigation of the relationships between spatial patterns and those variables influencing them has changed greatly during the past three decades. Emphasis has been placed upon the use of theory, probabilistic and behaviouralist interpretations and greater use of micro-scale studies of phenomena (Robinson, 1988). A range of work has also emphasised the role of physical, behavioural, socio-economic and political factors in determining the nature of agricultural change. This chapter will approach the review of these studies under those headings.

2.2 PHYSICAL FACTORS

Defining agricultural regions on the basis of physical factors was once a central task of agricultural geographers. This was performed at numerous scales, from the world (Whittlesey, 1936) down to individual counties in England (Tavener, 1952). A number of those studies analysed the effects of physical factors on crops yields (e.g., Granger, 1980a, 1980b; Gillooly, 1978; Gillooly and Dyer, 1979; Vermeer, 1981; Michaels, 1982; Dennet et al, 1980). Briggs (1981) evaluated relationships between spring barley yields and edaphic and climatic conditions. He concluded that sand content, drainage conditions and available water capacity of the soil, potential summer soil moisture deficit and annual accumulated temperature were the most important physical factors influencing yield. Ingersent (1979) evaluating potato production, argues that climatic conditions are responsible for the instability of potato yield.

Two major concepts have been used to determine the nature and importance of physical factors: ecological optimum and the margin of cultivation. (Grigg, 1982a) argues that every crop has minimum and maximum limits beyond which it can not be grown. Parry (1976), on the basis of his study of South East Scotland, argues that changing economic conditions could lead to an increase in cultivation in marginal areas. The idea of the margins of cultivation was also clearly demonstrated by Varjo (1979) in Finland. He applied the idea to the changing cultivation limits of barley, oats, rye and spring wheat between 1939 and 1969 and hypothesised that climate and profitability were the major causes for the changing limits of margins of cultivation. Some geographers (Bayliss-Smith, 1982; Simmons, 1979) have used an ecosystem approach to emphasise the flow of energy and nutrients within agricultural systems. Ilbery (1986) does not deny the importance of the physical factors, but states that the major factors of the scale of and the production type of the crop cannot be ignored as they may determine the nature of the effect of physical factors upon agriculture.

Grigg (1982a) argues that it is the interaction of physical and human factors, rather than physical factors alone, that determines patterns of agricultural land use.

2.3 SOCIO-BEHAVIORAL AND ECONOMIC FACTORS

With physical influences being increasingly modified by the effect of human agency through such items as fertiliser, irrigation and early ripening varieties of crops, it is not surprising that economic and social factors have been emphasised in the spatial structure of agriculture. Ricardo (1817) and von Thunen (1826) used the concept of economic rent to investigate patterns of agricultural production. The model has been described and examined in a range of texts (Morgan and Munton, 1971; Symons, 1978; Tarrant, 1974; Chisholm, 1979). Numerous studies (De lisle, 1982; Blaikie, 1971; Richardson, 1974; Golledge, 1960; Horvarth, 1969; Griffin, 1973; Ewald, 1976, and Van Valkenberg and Held, 1952), have been carried out on the basis of the von Thunen model but, in the modern context, the relative importance of distance and transport cost on agricultural location has declined. Sinclair (1967) argues that rapid urban development, rather than transport costs to the market, affects the intensity of agricultural production in the vicinity of cities, and he also claims that the intensity of agricultural production increases with distance from the market. His views have gained considerable support (e.g. Berry, 1979; Matlingley, 1972 and Bryant, 1974).

Harvey (1966) and Wolpert (1964) emphasise the importance of social conditions and human motives in farming. Butler (1960), in his study on the attitudes and motives of farmers, used the concept of a 'model' farm to distinguish farm units that deviated from the 'norm' for the area. Similar approaches, but using trend surface residuals as deviations from the norm, were adopted by Bowler (1975b) and Ilbery (1984b). Ilbery (1983a, 1983b, 1984b), in work on the goals and values of hop-growers in the West Midlands, considered the relationships to be those between farmers' behaviour and decisions about agricultural activity. Gasson (1973) developed a methodological framework for analysing farmers' goal and values. This framework was tested in East Anglia and amongst hop farmers in the West Midlands

(Ilbery, 1984b). In both cases, intrinsic social/cultural values were emphasised above expressive and instrumental values (Ilbery, 1986: 29). Gould (1963), applying game theory, determined the choice of strategies. Ilbery (1985) and Tarrant (1974) have criticised game theory modelling on the grounds of its complex and inapplicable analytical formulation.

Although the decision-making behaviour of farmers can be viewed as a reflection of a wide range of values (Gasson, 1973), many factors affecting decision-making are unpredictable (Hart, 1980). The choice of solution depends very much upon the type of farmer concerned and the expected attitudes towards risk avoidance. Techniques used to elicit farmers' attitudes include repertory grid procedures and point score analysis. The former has been used by Floyd (1976) and Townsend (1977), and point score analysis was developed to assess the relative importance attached by the farmers themselves to physical, economic and socio-personal factors in the decision-making process (Ilbery, 1977).

Another important set of decision-making models concerns the diffusion or spread of innovations, their adoption or non-adoption and the resultant effects on land use. Traditional approaches to diffusion studies focused upon the processes by which adoption occurs, or the demand aspect of diffusion (e.g. Jones 1967, Rogers and Shoemaker 1971), and these approaches have been evident in geography more generally in the use of Monte Carlo simulation models by Hagerstrand (1967). Hagerstrand produced a series of maps depicting the spatial distribution of the adoption process over time. Many subsequent studies were based on this idea (e.g. Misra, 1969; Johansen, 1971). The reliance of this 'adoption perspective' upon personal information flow has, however, been criticised in an agricultural context (Bowler, 1981). The idea of establishment of diffusion agencies to develop and implement strategies to promote adoption in their market areas has been emphasised in many studies (e.g. Brown, 1975; Brown, M. A. 1980; Brown et al., 1977; Brown and Letnek, 1973; Garst, 1974; Havens and Flinn, 1975; Yapa and Mayfield, 1978). All these studies have confirmed that motives other than maximum profit are important (Grigg, 1984). However, behavioural approaches have been criticised at a general level and Bowler (1984: 259) has stated that "when applied at a local level, the relative role of behaviour in relation to other factors is more difficult to discern".

The importance of economic forces as a major control over farmers' decision-making has been a feature in numerous studies of agricultural geography (Robinson, 1988). The role of economic factors in effecting changes in the patterns of farming activity has been suggested by Tarrant (1974: 11): "The economic factors of agricultural life never act in a entirely deterministic way but rather set limits within which farmers are able to operate; they define the freedom of choice".

Land holds a particular significance for agricultural production. As land varies in its fertility and in its relative value by location, such characteristics confer advantages on some parcels of land at the expense of others. Grigg (1984) argues that the productivity of the resource base, inheritance laws, and the role of the state can not be ignored. The productivity of the resource base (the combination of soil, climate and topography) can be associated with variations in farm size. Proximity to urban areas also influences farm size structure at the local level. Ilbery (1986) argues that since farm structure is a major determinant of income, structural reform is the best solution to poor incomes. Many studies on this aspect have been carried out and examined by various authors (e.g. Bowler, 1983; King, 1977; King and Burton, 1983; Clout, 1968, 1975; and Naylor, 1982). A number of agricultural trends are associated with the variations in farm size can be found in Bowler, 1983; Lund and Hill, 1979; Found, 1971; Todd, 1979; and Clark, 1986. The transformation of farm size has thrown a number of social trends in rural areas into relief. Perhaps the most significant has been the intensification, in some rural regions, of the long term trend of outward migration of farm families and farm workers. There have been fears about the economic and social sustainability of farms (e,g, Bertreley and Todd, 1990; Hart, 1991; and Fuller et al., 1990). The changing size structure of farming has also had implications for social relations within rural communities (Gregor, 1982).

Land tenure has a broad relationship with farm size; rented holdings in the UK, for example, account for almost half the total holdings over 200 ha in size (Bowler, 1992). Tenure also influences the complexity of decision-making for the farm business, and has consequences for capital investment on the farm and financial returns. Hill and Ray (1987) argue that tenants are not more efficient than owner-occupiers except in certain size groups (e.g. small specialist dairy farms), and large scale arable and mixed farming seem more efficient under owner occupation. Farm size and land tenure also have a differential influence on the internal relations of the farm business. Broadly speaking, owner occupation or long leases give some sort of feeling of satisfaction or security and long-term planning benefits, and under these circumstances, farmers try their best to improve agricultural productivity of land. On the other hand, very short leases produce insecurity for farmers which, in turn, does not permit long-term planning or farm improvement (Bowler, 1992).

Whatmore (1991a) categorises all new trends into two major themes: the role of non-farm elements and new technologies in agriculture, and the survival of family producers particularly through the diversification of farm income and land use. Marsden and Little (1990) argue that developments in food manufacturing and retailing sectors are increasingly influential in the UK agro-food system. Ward (1990) identified the corporate characteristics of key firms in the non-farm sectors of the food chain in the UK. Capital represents those human inputs deliberately created to aid production: seeds, fertilisers, machinery and buildings, farm roads and drainage systems. The amount of working capital deployed depends on the technological status of the industry and is influenced by government incentives (capital grants or tax relief) to invest (Munton, 1992). Capital investment is subject to the effects of inflation and changes in the rate of interest on borrowed money, and is encouraged or discouraged by specific agricultural policy measures and general changes in taxation. In all advanced economies, capital investment has resulted in starting increases in output per hectare and per worker. In the case of the UK, the value of the grass product per whole-time equivalent has risen by more than 5 per cent per annum at constant prices since 1971, while assets per worker have risen at a rate in excess of 13 per cent per annum (Munton, 1992: 76). The main force for change has been the continuing capitalisation of production with its distributive effects on the number and the size of farm businesses and on land use and labour (Munton, 1992).

Several studies have analysed the importance of technology and biotechnology development. Busch et al. (1989); Kenney et al. (1989) and Munton et al. (1990) have focused upon the influence of technology change upon agriculture. Molnar and Kinnucan (1989) provide a highly detailed study of biotechnologies and their significance for agricultural restructuring. Goodman and Wilkinson (1990) focus upon the patterns of research and innovation in biotechnologies within the agrofood system. Some of these themes are brought together by Lowe et al. (1990).

Intensification of agriculture under the CAP has led geographers to evaluate the effects of this intensification on the environment (Goodman and Redclift, 1991; Green, 1986; Lambert, 1990; O'Riordan, 1987; Potter, 1986a, 88, 91), on wildlife (Soper and Carter, 1985), and on the rural landscape (Blunden and Curry, 1985; Blunden & Turner, 1985; Lowe, et al. 1986, and Shoard, 1980, 1987). McCorriston and Sheldon (1989), estimating the impact of EC accession on agro-inputs, show that accession has resulted in the expansion of export markets amongst agricultural supply industries (Whatmore, 1991a). Recent studies (Alexandratos, 1990; Down, 1991; Moyer and Josling, 1990; Robinson, 1993) examined the trends and patterns of CAP reforms (farm diversification, set-aside, farm woodland promotion).

Marsden et al. (1989) identified the diversification into non-farming activities as one such strategy which can play different roles in different family and business circumstances. There is growing literature on the work women undertake on farms (Jones and Rosenfield, 1981; Gasson, 1984, 1989; Little, 1990; Whatmore, 1991b), with increasing attention given to gender relations within the farm family (Bouquet, 1985). Symes and Marsden (1983) argue that on large farms, the woman's role has become less central to farming operations, with well-educated wives increasingly seeking off-farm employment. On family farms, their work still tends to be dominated by book-keeping, answering the telephone and caring for animals. In these circumstances, wives provide an essential but undervalued 'backup' service, although there is some evidence that they are increasingly involved in more important business decisions (Gasson, 1984).

Farm-based accommodation and tourism as one avenue of diversification is discussed by Evans and Ilbery (1989). Others have focused more closely on the diversification of land use. For example, Guyer and Edwards (1989) analysed the potential contribution of farm woodland to the rural economy of Northern Ireland, while Ilbery (1990) assessed the pattern of uptake of the arable set-aside scheme in England. Whatmore et al. (1990) focused on the struggle over development rights in agricultural land and the realignment of landowning and industrial capital including farming, implicated in this process.

2.4 GOVERNMENT AND AGRICULTURE

The theme of the state is an area in which geographers have made important contributions to the development of an understanding of the agricultural political economy (Whatmore, 1991a). Government policies have been particularly influential in the last few decades, encouraging or discouraging farmers to adopt certain agricultural systems. Most theoretical explanation is broadly of the positivist or behaviouralist tradition (Bowler and Ilbery, 1987). They state that there was a need then for agricultural geography to extend its theoretical base to encompass the structuralist perspectives of political economy. "The political economy approach leads to a critical analysis of the economic, societal and political structures within which the food chain operates, especially as regards the changing relationships between the state, capital and labour" (Bowler and Ilbery, 1987: 329). Only a few geographers (Blaikie, 1985; and Marsden et al. 1986a and 1986b) have adopted this political economy perspective, although others have investigated state-agriculture relationships using more traditional conceptual models (e.g. Bowler, 1979; Briggs, 1978). Marsden et al. (1986a) have suggested a possible framework (uneven development; geographical and historical specificity; conceptualisation of the family labour farm; agriculture and state policy) for the effective study of agricultural change via a political economy approach. Various terms have been used to describe the restructuring of agriculture, including 'farm modernisation', 'agricultural industrialisation', 'agricultural rationalisation' and 'the second agricultural revolution' (Bowler and Ilbery, 1987). Thus it has been argued that "the traditional approach to agricultural geography disregards the absorption of the production (farm) sector into the large supply system which encompasses off-farm agri-inputs (fertilisers, machinery etc), food processing, distribution and consumption" (Bowler and Ilbery, 1987: 327). Large corporations have become involved in the food supply system as part of moves from agriculture to agribusiness. Under the process of economic development, agriculture has lost its distinctive character and has become absorbed within more general processes reinforced by agribusiness (Bowler and Ilbery, 1987). The work of Marsden et al. (1990), written within a broadly political-economy perspective, examines in more detail the local experience of the restructuring of agriculture for farm livelihoods and rural society (Whatmore, 1991b).

Bowler (1979) has identified three main factors which, to varying degrees, explain the power of agriculture in the political process: first, various active and vociferous groups; second, the social and economic problems of agricultural industry; and, third, the direct political voting power of farmers. These three factors influence the government in various ways and in varying degrees in formulating policy, keeping in view any national interests which are beneficial to the agricultural sector. For example, the National Farmers' Union in the United Kingdom (and its counterpart in the United States) lobby for their interest in the political process. Talbot and Hadwiger (1968) report that farmers in the United States switch parties more than any other occupational group and that this generates political leverage with the two main political parties. The intervention of government in the agricultural sector also has great potential to change agricultural conditions, at regional, national and international (e.g. GATT) levels.

Government intervention can be in various forms ranging from price and production controls to marketing boards, structural reforms, and grant aid and income supplement. "A structural theory of state-agriculture relations allows for unequal power among interest groups in shaping agricultural policy. For example, in most developed countries farm groups and industrial capital appeared to have enjoyed more influence than consumers and taxpayers in recent years" (Bowler, 1992: 27).

More recently, interest has shifted to negotiations between individual states, or groups of states at the international level-forums such as the General Agreement on Tariffs and Trade (GATT). These international negotiations have caused states to re-appraise their farm policies with a view to reducing levels of price protection and subsidy.

The significance of the relationship between government and agriculture in developed countries stems primarily from the international influence exerted by agricultural problems and policies. International trade in agricultural commodities exemplifies the close interdependence of all economies in the world. The European Community, for example, is both the major exporter and importer of agricultural products in the world, while for the United States, agricultural output contributes a greater share by value to world agricultural exports. Consequently the agricultural policies of the EC and the United States can have a significant effect on the international market. Le Heron (1989) examines the central role of government policy in the political economy of New Zealand livestock farming. Cloke (1989) has also examined the process of state de-regulation and its effects on the agricultural sector and similar issues are examined with respect to Swedish agriculture by Peterson (1990). Studies such as Burmeister (1990), Tarrant (1990), Tracy (1989) and Tubiana (1990) have also examined state-agriculture relations.

2.4.1 Agriculture before the CAP, 1920 to 1972

Although, in Britain, government intervention in agriculture may be considered to have begun in a major and sustainable way in the middle of the nineteenth century, I shall here trace intervention only for the opening decades of this century. Under the 1925 British Sugar (Subsidies) Act, government granted direct subsidies to beet growers. The 1925 Act brought an immediate response in terms of the growing of beet. Government intervention entered a new phase of development with the 1932 Import Duties Act and the Ottawa Agreement Act, imposing import duties and restricting quantities of imports. Later, through the Agricultural Marketing Acts of 1931 and 1933, the government established marketing boards to control hops, milk, pigs and potatoes. Under the Wheat Act of 1932, producers received a subsidy to fill the price gap between the average price of British wheat and a standard price. This scheme was later extended to milk and other cereal and livestock products. The major objectives of these measures were to stabilise and, in some cases, revive the farming interest. These policies brought an increase of 583,000 acres in the arable area between 1932 and 1938. Under the 1939 Agricultural Development Act, a ploughing grant was awarded to encourage crop output. The result was an increase of 8 million acres at the cost of £16 million (Robinson, 1988: 149). In addition to the ploughing grant, there were also some investment grants to encourage field drainage and water supply, subsidies on the price of fertilisers and special grants to improve farm buildings in upland regions.

The 1947 Agricultural Act was introduced after the Second World War to stabilise the agricultural and economic sector. This Act controlled British agriculture until 1973. The principal objectives of the Act were an adequate supply of food and efficient use of agricultural resources. The policy operated by means of marketing boards, a guaranteed price system with deficiency payments and, from 1964, the control of cereal import prices. The policy brought about major changes in British agriculture. The major effects were to stabilise the agricultural industry, increase demand, promote farm mechanisation, initiate a decline in agricultural labour, increase agricultural production by two-fold improve living standards and, overall, it lead to rising agricultural output through high labour productivity, increased agricultural inputs, and large farms. Government intervention was not only evident in terms of subsidies and marketing boards but also through an infrastructure of research, advisory and educational services. Schemes such as the Calf Subsidy (1949), the Ploughing Grant (1952-67), the Hill Cow Subsidy (1943), the Hill Sheep Subsidy (1940), the Farm Improvement Grant (1957-70), and the Hill Farming and Livestock Rearing Grant (1946-63) were introduced to improve the agricultural sector of the economy. The general picture of change in British agriculture in this period has been discussed by researchers such as Holderness (1985), Tracy (1989), Parry (1976), Robinson (1988), and Grigg (1989).

2.4.2 The nature of the CAP

The Common Agricultural Policy (CAP) of the European Community (EC) is a system of policies developed to achieve the objectives of the Treaty of Rome. The CAP was formed under the Treaty of Rome of the European Community for co-operation in economic development with particular emphasis on agriculture. "The impetus to set up the EC came from the Benelux countries (Belgium, The Netherlands and Luxembourg) in the mid-1950s. A number of committees were set up to discuss the various issues involved and from their findings a report, the Spaak Report, was drawn up early in 1956. This report formed the basis on which the Treaty to establish the EC was built" (Fennell, 1979: 5). The treaty for the formation of a EC, the Treaty of Rome, was signed in March 1957 and came into effect from the 1st January 1958. Initially, there were six members: the Federal Republic of Germany, France, Italy, The Netherlands, Belgium, and Luxembourg. Other states have since joined: in 1973 the United Kingdom, Ireland and Denmark; in 1981 Greece; in 1986 Spain and Portugal, and from January 1995, Austria, Sweden and Finland. The Treaty establishing the EC contained 248 articles of which ten applied directly to agriculture. Many others applied indirectly to agriculture given the concentration on economic development (Fennell, 1973, 1979; Hill, 1984; Lintner, 1989; Marsh and Swanney, 1980; Morrice, 1980).

"In 1958, over 15 million people, more than 20 percent of Europe's working population were engaged in agriculture. The 6.5 million holdings were small and fragmented despite existing national support policies, agricultural incomes were generally about half those in the non-agricultural sector" (Hill, 1984: 20). It was, then, very important for the founder countries of EC to formulate a CAP for the welfare of the rural population. The most important of the ten articles of the Treaty of Rome related to agriculture is Article 39 which outlines the objectives of the CAP. Other articles (38, 40-47) also deal with agriculture but are less important. These articles together state how the objectives of Article 39 should be achieved e.g. establishment of common markets for agricultural products, establishment of funds to finance the common organisation of markets and measures to be taken in the fields of vocational training, research and the dissemination of agricultural knowledge. The objectives of the CAP as laid down under Article 39 of the Treaty of Rome are: to increase agricultural productivity by promoting technical progress and by ensuring the national development of agricultural production and the optimum utilisation of the factors of production, in particular, labour; to ensure a fair standard of living for the agricultural community, in particular by increasing the individual earnings of persons engaged in agriculture; stabilise markets; assure the availability of supplies; and ensure that supplies reach consumers at reasonable prices (Hill, 1984: 19).

The CAP is based on four main principles (Marsh and Swanney, 1980). Even after the reforms of CAP since 1988, the principles have not changed. These principles are the free movement of agricultural goods within the community; common prices; a common tariff wall against third country imports; and joint financial responsibility (See Figure 2.1).

The CAP is financed by the European Guidance and Guarantee Fund (FEOGA) which is the financial institute of EC through the member states. Under this financial system, all levies and custom duties are to accrue to the community, and additional expenditures are met from national value added tax (VAT). For expenditure purposes, FEOGA is divided into two sections: guarantee and guidance. The former finances the expenditures of common market organisations for agricultural products to support the price and income policy, and uses the major share of FEOGA. The latter provides funds for agricultural structural policy.

The prices for CAP agricultural commodities are annually reviewed by the Commission. The proposal for new prices is discussed by the Commission, the European Parliament, commodity management committees and some public bodies which represent producers, consumers and manufacturers, and is then forwarded to the Council of Ministers for a decision.

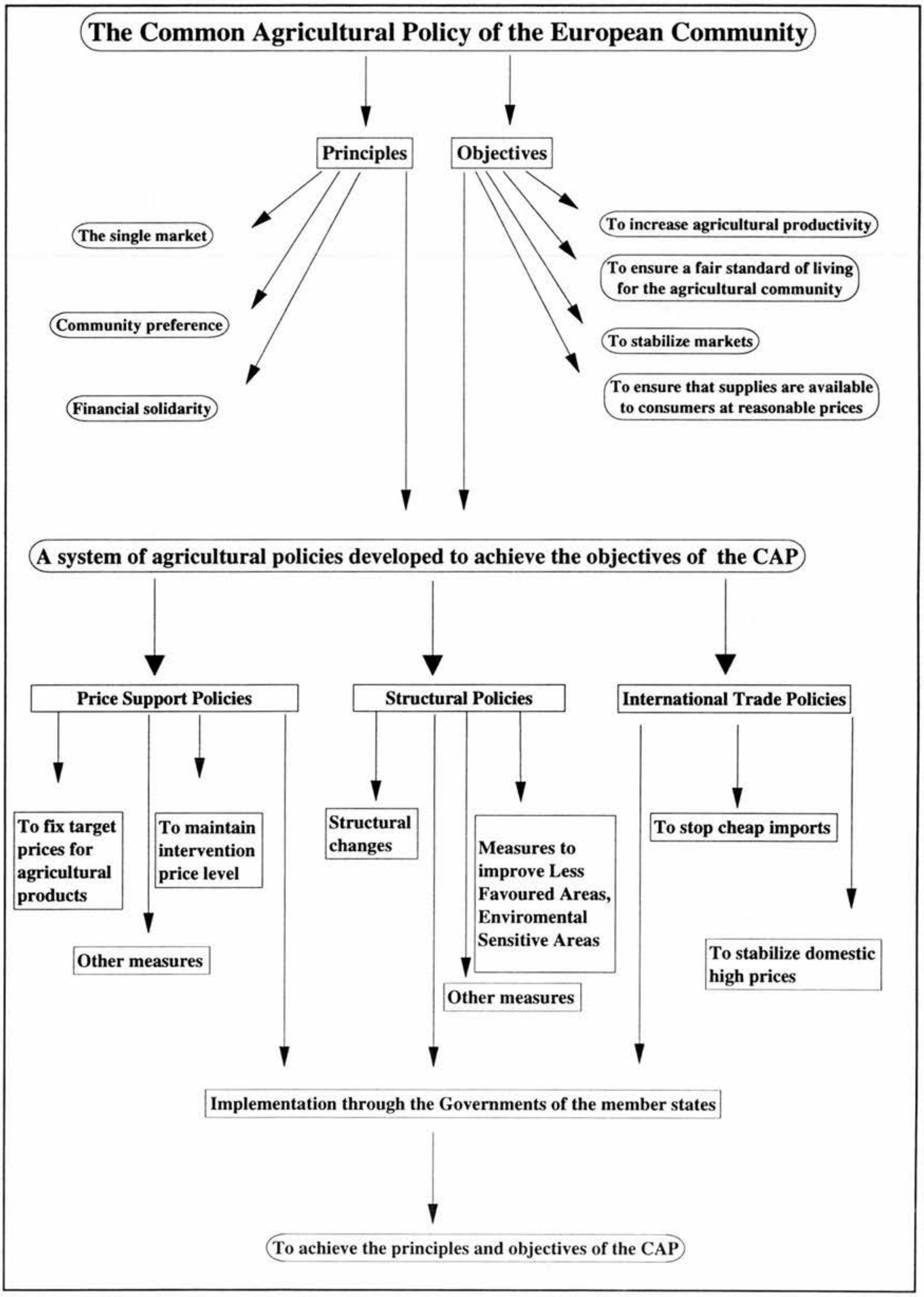


Figure 2.1 Principles and objectives of the CAP

The price policy is concerned with maintaining internal prices for EC farmers. It is based on controlling markets to achieve a desired level of prices. There are three principal instruments which are used to support the system of prices and market management: variable levies on import; intervention purchasing arrangements; and variable export subsidies. Some other measures are applied according to circumstances e.g. storage and consumer subsidies, withdrawal of supplies from market, voluntary import restraint, offsets to high prices for domestically-produced inputs and deficiency payments. Other measures are also used to fix the commodities' prices.

"Attempts by governments to influence directly from employment, farm size and the distribution and quantity of capital are generally called structural policy" (Marsh and Swanny, 1980: 38). Structural policy is directed to the general objectives of the CAP as laid down in Article 39 of the Treaty of Rome. In the early 1960s, the average farm size was just under 11 hectares. About half of the 6 million farms were under 5 hectares. This is evidence of the need to take steps to develop farm structure. Efforts to improve farm structure started in 1964 but had little effect before 1967. In 1967, the Commission proposed a farm restructure plan known as the 'Mansholt Plan'. This was to be based on forming 'enterprises of adequate size' by reducing the size of the agricultural population. Two measures were proposed: firstly, help people to take up alternative occupations or to retire and, secondly, assist in modernising the farms. On the basis of these proposals, the Council adopted three basic directives on structural reform in 1972. They were concerned with farm modernisation, improvement of farms, retirement from agriculture and training and advice to farmers. The CAP initiated a later round of structural reforms in 1988 and these reforms were further modified under the 'Macsharry Proposals' and the GATT negotiations.

The CAP's agricultural trade policy is designed to protect internal markets and to promote sales to external markets. It takes the form of a common customs tariff at the external frontiers, varying according to the product and trading partner. A number of measures are used in the form of levies on the imports and exports.

A number of changes have occurred in the EC agricultural sector under the CAP. They include technological advances, high production, changes in farming structure, socio-economic changes and changes in agricultural trade within the EC. These changes have in turn affected the structure and growth of the agricultural sector in those developed and developing countries who were major exporters to the EC, and affected also the structure of agricultural production within the community facilitating huge production totals as compared with consumption. The EC has become self-sufficient in a number of products and also a net exporter of wheat, sugar, beef, veal and dairy products.

The consequences of the CAP have been evident in the form of huge agricultural surpluses, mounting agricultural expenditures and plummeting farm incomes and, finally, growing international tension. There have been very strong criticisms of the ways through which the CAP has been run and demand for reforms of the CAP has been an integral part of those studies of the CAP (e.g. Alexandratos, 1990; Bureau of Agricultural Economics, 1985; Down, 1991; Handriks, 1991; Moyer and Josling, 1990; Pearce, 1981). In 1987 the EC moved towards making changes in its agricultural policy. The basic proposals were formulated in 1985 in the form of a 'Green Paper', and were further amended in 1987. The reforms of the CAP were approved in 1988 and were immediately implemented in the EC (Commission of the European Community, 1989). Under this new policy, without any change in the basic principles, the emphasis was on the reduction of surplus production, milk quota arrangements, low agricultural prices, maximum guaranteed quantities, penalties on producers for high production and quality in place of quantity. Further, different schemes such as set-aside, extensification and diversification were introduced to encourage the farmers to reduce agricultural output. Under structural measures, support for small farms providing direct income aids and an early retirement scheme were offered to farmers to leave or to reduce farming practice.

2.5 THE RURAL LANDSCAPE IN S. E. SCOTLAND BEFORE 1972

The rural landscape of South East Scotland has evolved over a long period with legacies stretching as far back as the Iron Age and with Anglo-Saxon influences in the fifth and sixth centuries AD, but essentially it derives from the agricultural improvements of the eighteenth and ninteenth centuries. The arable land in pre-improvement Scotland(before the 18th century) had no permanent internal boundaries between the various strips and blocks of land and was organised around a type of open field system. Two major phases of rural landscape change can be traced between the 18th century and 1972: firstly, between 1750 to 1850 when the present landscape was created and secondly, the post-war period (since the 1940s) when landscape began to be reshaped. These phases of landscape evolution have been used as a background of this study.

2.5.1 The landscape of Improvement and the Enclosure Movement, 1750 to 1850

This process of landscape amalgamation landscape was largely dominated by the improvement and enclosure movement which took place between the period 1750 and 1850. Changes in Scottish agriculture from the seventeenth century involved changes in land tenure and other improvements depending, in particular, on the granting of long leases. Change in the land tenure system was the most important factor in initiating the agricultural improvements. The process of amalgamating the fragmented and intermixed strips and blocks of land was, mostly, easily achieved and rapidly undertaken by landowners. Land lying as runrig between different tenants could simply be reallocated by landowners into compact blocks. Where different proprietors had intermixed lands the process of consolidation was more difficult. However, this problem was solved by an Act passed by the Scottish Parliament in 1695 (Whyte, I and K. 1991).

In 1714, for example, John Cockburn of Ormiston in East Lothian introduced improved farming methods by granting long leases on favourable terms to his tenants if they agreed to begin enclosing their farms with hedges and ditches. An early improver in East Lothian was the sixth Earl of Haddington who, in the early eighteenth century, began to enclose land and lay out plantations on sandy coastal soils and planted larger blocks of woodland. In most cases, a new tenant not only obtained a nineteen years lease but was also often required to adopt improving methods, such as fencing, dyking, manuring or introducing green crops and regular rotations. Improvements in roads, the building of bridges, and the introduction of canals, then railways, allowed for local specialisation in agricultural production. (Millman, 1975; Parry and Slater, 1980; Whyte, I. and K., 1991).

Enclosure was the most obvious and, for many people, the most fundamental aspect of agricultural change. The first enclosures took place around the mansions of proprietors on the Mains or Home Farms and were often very regular in layout. Later fields on tenanted holdings were larger. "The variations of field patterns, farm sizes, type of enclosure and farmsteads varied according to the ideas, contacts and sometimes idiosyncrasies of the laird and his land surveyor within the context of environmental characteristics, financial and material resources and the dictates of economic conditions" (Parry and Slater, 1980: 219).

The layout of the fields was dependent on the size of the farm, type of soil, and on the type of farming envisaged. The field patterns laid out by the improvers were generally rectangular rather than square, but some of the less regular boundaries took account of local topography. The size of fields was often dependent on soil type: fields on light dry soils were larger so as to accelerate ploughing, harrowing and reaping, and smaller on clay soils. Large fields were generally preferred to small fields as hedges and trees reduced the agricultural area. Field sizes varied throughout Scotland such as in Berwickshire, where the fields were of 6 to 12 ha on the clay soils and 12 to 20 ha and even 28 ha on the lighter soils reflecting the large farm sizes.

The actual form of field boundary used was either stone dyke, hedge or ditch depending on local availability of materials, underlying land, costs and the views of the proprietor or land surveyor. The enclosures were bounded by open ditches in low-lying areas like the Carse lands of the River Forth. Elsewhere, hedges, usually of quick-growing hawthorn, were planted. Throughout the uplands where hedges would not thrive and in many lowland areas, too, the drystone dyke was the normal field boundary. Walls in lowland areas were frequently made of 'field stones' thrown up by cultivation. Hedges, though they took longer to become established, became better barriers as they aged and added variety to the landscape. Sometimes ditches were dug on both sides of the line of fences and a thorn hedge was planted on top. To give more stability, combinations of dykes and hedges were sometimes built. In other cases, particularly in flat, carse areas, simple open drains were used to divide the fields, but usually a hedge was planted on top of the mound formed by excavated materials. Millman (1975) presented a very good example of the nature and extent of enclosures in Ayrshire (Figure 2.2)

The role of shelter belts has always been to provide shelter rather than timber. On the better soils of the farms, ash, beech, elm and sycamore and on poor soils, alder, birch, rowan and willow, were planted as shelter belts. The appearance of new farmsteads depended on the size and nature of the farm. Farms tended to be larger in the more arable-oriented east of Scotland. In areas where farms were smaller, such as the north east, and in the dairying areas of the western Lowlands, 'U-shaped' courtyards or simple 'L-shaped' blocks of outbuildings continued in use. As agricultural technology developed and powered machinery was introduced, modifications were made in the farmsteads to accommodate these changes. The provision and improvement of roads played an essential part in the development of the reshaped landscape, for it enabled free movement of farm produce and carriage of lime and dung. As agricultural improvement proceeded, roads were diverted round the walls of policies and former tracks running through open fields were replaced by new roads. Commercial forestry was introduced in Perthshire in the early eighteenth century. In the southern Highlands and Central Lowlands, many landowners joined the planting in the second half of the eighteenth and in the nineteenth centuries. Throughout the nineteenth century planting continued, at a varied pace according to the landowner, in parts of the eastern and southern Highlands, the Lowlands and the valley of the Uplands (Millman, 1975).

The first Agricultural Society in Scotland was founded in 1723, and from this date the 'Improving Movement' gathered momentum. From about 1760, the rate of

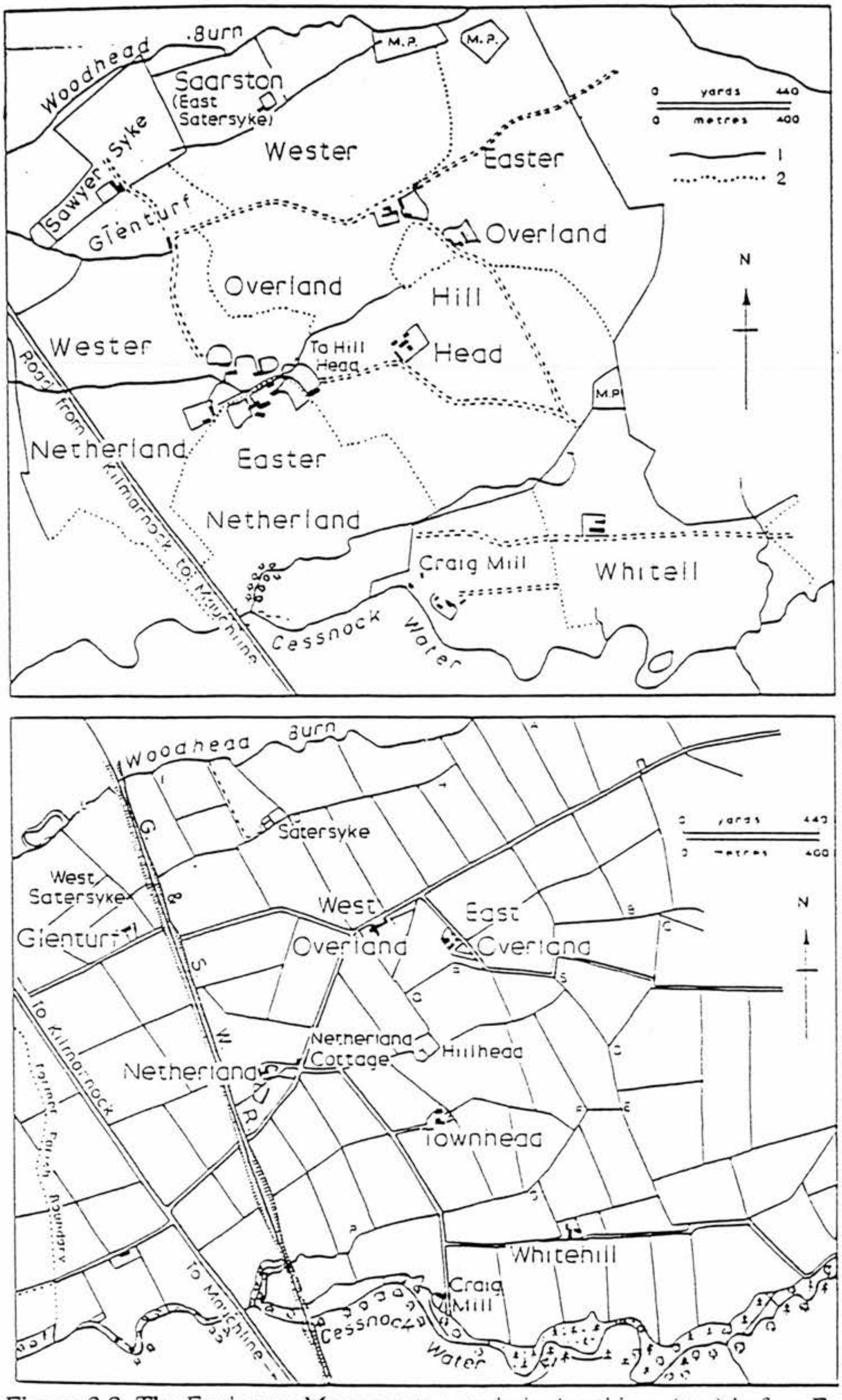


Figure 2.2 The Enclosure Movement: a study in Ayrshire - (top) before Enclosure; (bottom) after Enclosure.
Source: Millman (1975)

change accelerated rapidly and the last few decades of the eighteenth century saw the landscape of many parts of the Lowlands totally transformed. The chronology and scale of transformation varies from one district to another. In progressive areas like the Lothians, improvement began earlier - from the 1730s - and had been largely completed by the 1790s. In areas like the north-east, large-scale changes did not begin until the 1770s and 1780s (see Adams in Parry and Slater, 1980). The landscape continued to be modified during the nineteenth century, particularly during the mid-century period of 'High Farming', when landlord and farmer alike were prepared to sink a substantial proportion of their profits into improvements like underdraining and the introduction of steam threshing machines.

2.5.2 The landscape of the post-war period, 1945 to 1972

From the evidence available, there is little doubt that the agricultural landscape of Scotland was almost entirely created during the improvement period. Further changes in the countryside began to appear in twentieth century with modernization of agriculture. Bower and Cheshire (1983) claim that, since 1947, the industrialisation of agriculture has replaced the traditional systems with new intensified methods bringing large fields and expanding agricultural production. In those parts of the country whose climate is best suited to the production of cereal crops, the agricultural landscape has undergone the greatest change. The consequences of agricultural intensification have been an acceleration in the rate of modification of the landscape. For instance, the general use of large machines has prompted field enlargement and the removal of hedgerows and stonewalls (Barr et al., 1986; Blunden and Curry, 1985, 1988; Blunden and Turner, 1985; Newby, 1988; Shoard, 1980, 1987; and Ward et al., 1985).

The availability of greater area for arable purpose and the saving of time resulting from the process of field amalgamations encouraged farmers to enlarge their fields. Edward (1970), for example, calculated the effects of increased field size on time spent turning machinery at row ends (assuming a speed of 3.2 km h^{-1} and a turning time of 36 seconds). An increase in field length from about 110 m to 800 m reduced the turning time about 80 per cent. Green (1981) calculated that a change from a row length of 200 m to 500 m, which in a square field would mean an enlargement from 3.25 ha to 20 ha, could save 15 per cent in work time. This has provided an additional significant bonus to farmers by making available for productive purposes one hectare of land for every 0.88 km of around two metres-wide hedge removed (or nearly five acres for a mile of two-yard-wide hedge). Green (1981) also suggested that with a 2 ha field, 2.6 per cent of the land is under hedgerows (assuming a average width of 2 m). These changes have been greatest in those parts of the country whose climate is best suited to the production of cereal crops.

In the regions, the agricultural landscape has undergone change through removal of hedgerows and the amalgamation of small fields into larger units. The removal of field boundaries, especially hedgerows, is one of the characteristics of agricultural intensification that has been most widely criticised. In Britain in the period 1951-75, 80,000 kilometres (nearly 50, 000 miles) of hedgerows were removed (Blunden and Curry, 1985: 25). Bowers and Cheshire (1983), in a study of West Berkshire, stated that there was a decrease of 35.5 % change in the length of hedgerows between 1947 and 1976 (a total decline of 1.2% p.a.) which fell by a further 10.9 % from 1976 to 1981 (about 2 % per annum). "The area of West Berkshire has thus seen most of the changes which typify post-war agricultural 'improvement' and rural gentrification" (Bower and Cheshire, 1983: 49). Shoard (1980) stated that about 120,000 miles in all or 4500 miles a year of hedgerows had been removed in England and Wales between 1946 and 1974. Moreover, in 1978, 74 miles of hedgerows in England and Wales were grubbed out in the course of preparation for new drainage schemes alone to stop their roots fouling new drains. There was also a loss of 1087 miles of hedgerows in Worcestershire between 1900 and 1976, and farmers in Herefordshire removed an estimated 3730 miles during the same period. In Norfolk, 8000 miles of hedgerows were removed between 1946 and 1970 (Shoard, 1980). In a study carried out by the Countryside Commission Scotland (CCS) and Nature Conservancy Council (NCC) in the Grampian region of Scotland, an estimated 6000 km of hedgerows was shown to have been removed between the 1940s and the 1970s. The net change of hedgerows was -41.51% and a net change in tree line length was -121.89 km (-5.61%) with some variations. (CCS and NCC, 1989). Some changes in other farm features which are highly associated with agriculture (farm buildings, paths along fields and ponds/wells) have also been part of change in rural landscape under the post-war agricultural revolution. Bowers and Cheshire (1983) concluded that paths which are more associated with hedgerows have also been removed due to the loss of hedgerows. Moreover in Berkshire within the sample area studied by Bowers and Cheshire the number of ponds was reduced from 25 in 1947 to 17 in 1981. Westmacott (1983) also suggest that removal of farm features such as dispersed trees, farm buildings without residence and ponds/wells have been removed under the process of enlargement of fields. CCS and NCC (1989) also noted that unsurfaced paths which are associated with hedgerows were also decreased by 158.86 km (-4.88%). It can be seen therefore, that field amalgamations and all the associated changes in traditional farm features, greatly affected the visual landscape.

The changing patterns of woodland (loss of broadleaved woodland and gain of coniferous woodland) have also been a significant factor of rural landscape change. Essex (1987) has emphasised that agricultural intensification is a cause of neglect of woodland because farmers' time is diverted to other more profitable agricultural enterprises. The CCS and NCC (1989) reported a loss of one-third of the broad-leaved woodland but a four-fold increase under coniferous woodland. The Macaulay Land Use Research Institute (1992), in a study of the central lowlands of Scotland, estimated that there had been a three-fold increase in the area of woodland cover from 1946 to 1988, an increase largely due to the establishment of coniferous plantations. Bowers and Cheshire (1983) state that the most recent change is loss of woodland in Berkshire, where a large part of the woodland area was converted to golf courses. It is interesting that this is a current cause of main concern in East Lothian, particularly along the coast.

Although large-scale mechanisation, modern farm buildings and changes such as field enlargements and removal of hedgerows have altered the landscape in recent years, the basic features of the Lowland countryside today are still those of agricultural improvement and the enclosure movement.

2.5 SUMMARY

This chapter began by showing the different 'traditions' that have informed writing on the geography of agricultural change. Traditionally agricultural geographers devoted much attention to the physical environment, recognising the diversity of production systems and the complex spatial patterns of agriculture's distribution reflecting the interaction between physical and economic variables. Attention has more recently focussed on changes in the economic and political variables affecting agriculture. Instability in economic variables can play a major role in influencing the timing and nature of change in the agricultural system. If other relevant factors, such as personal or behavioural characteristics are added to the interaction of physical and economical factors, agricultural land use can be seen to be the product of a complex inter-meshing of forces. The involvement of the state in agricultural affairs has brought enormous change to the study of agricultural geography. The state influences agriculture through policy formulation and by providing different sorts of financial aids and subsidies. The changes affecting agriculture under the 1947 Agricultural Act and under the CAP in 1973 have particularly influenced agriculture in Britain. It has been demonstrated that one of the major effects of agricultural change has been upon the rural landscape. This has been evident in the clearance of pre-existing boundaries, in replacement of one boundary type by another and by changes in the semi-natural vegetation as well as in the extent of woodland.

In the next chapter, attention is paid to those data sources which can be and have been used to investigate agricultural and rural landscape change . What follows also explains the methods used in carrying out this study.

CHAPTER 3

DATA SOURCES AND METHODOLOGY

3.1 INTRODUCTION

In this chapter, the data sources used in this study are described. The methodology for the selection of the study area, for the analysis of agricultural change, and for the selection of rural landscape features and the sample evaluated in this study is explained.

3.2 GENERAL METHODOLOGY

The aim of this study is to investigate the effects of agricultural change on the rural landscape during the period (1972 to 1990) under the CAP. South East Scotland was chosen as a focus for this study. Two sample areas in South East Scotland, one in East Lothian and the other in Berwickshire, were selected to investigate in more detail changes in the rural landscape. A field survey through postal questionnaires was carried out to explore the relationship between agricultural and rural landscape change in South East Scotland, focusing upon the sample areas. Agricultural change is investigated using agricultural statistics at parish level for selected time intervals between 1972 to 1990. Although these data can not give an unequivocal indication of the causes of changes in the rural landscape, it can be argued that changes in cropping patterns, farm holdings, land tenure and other land uses (changes in woodland and area under natural and semi-natural vegetation) may be elucidated and may explain the role of agricultural change in determining the rural landscape change. Figure 3.1 shows the general methodology of the study.

Changes in rural landscape have also been examined through questionnaire survey. The survey sought to investigate the connection between agricultural and landscape change at farm level and the main evidence for the intensification of agriculture and the disappearance of rural landscape features, (cf. the studies, cited above). It was initially hypothesized that rural landscape change would have occurred

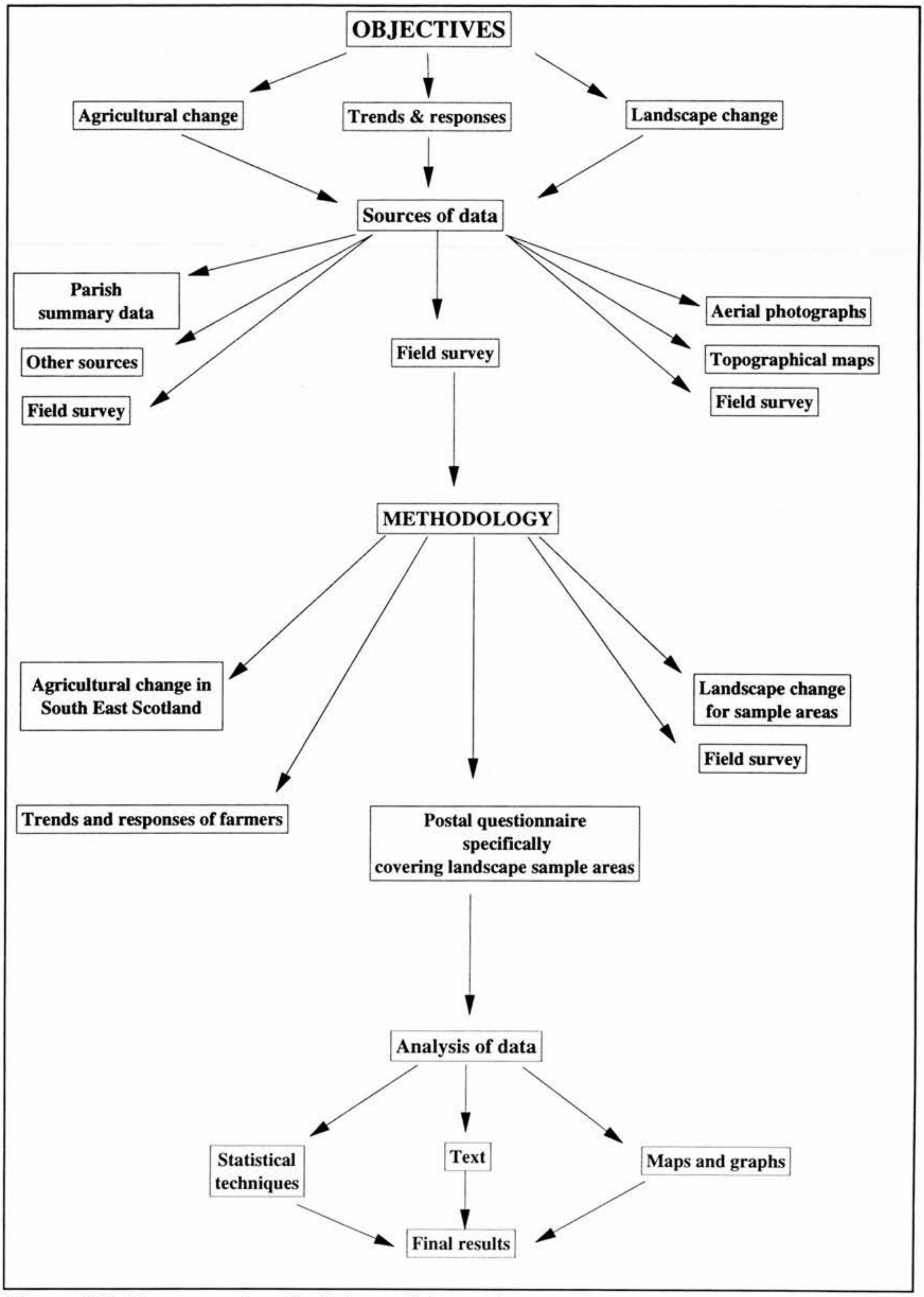


Figure 3.1 The general methodology of the study

in the area. The intention was, then, to evaluate the nature of any such agricultural and rural landscape change using the study area and sample areas in particular.

3.3 DATA SOURCES

3.3.1 The agricultural census and other statistical sources

The agricultural census is a comprehensive source of information about agriculture. The nature of its information varies ranging from data on farm size to farm buildings, figures of crop production and livestock production, farm incomes and farm labour. Agricultural data are available for the whole country and for regions and districts and smaller areas such as parishes.

In the United Kingdom, early attempts at collecting agricultural information during the Napoleonic War were undertaken by Justices of the Peace or the Clergy between 1795 and 1803 (Clark, 1982a). The 'Old' Statistical Account of 1791-9 provides a description of agriculture and rural society at parish level in Scotland. The Board of Trade became involved in the collection of agricultural statistics in 1836, and in Ireland an agricultural census was conducted in 1847. The first full-scale national agricultural census of Great Britain was held in 1866 (5 March for livestock and 25 June for acreage of crops) by the Board of Trade. In 1888, responsibility for conducting the agricultural census was transferred to the Board of Agriculture which became the Ministry of Agriculture in 1912. In 1912, the Board of Agriculture for Scotland (a part of the Scottish Office), which conducted an agricultural census, became the Department of Agriculture for Scotland in 1929 and the Department of Agriculture and Fisheries for Scotland (DAFS) in 1960. The census taken between 1866-1918 and 1921-1925 was voluntary. After the 1925 Agricultural Returns Act, which was superseded by the Agricultural Act 1947, it was compulsory for farmers to provide the information requested (Clark, 1982a).

The British agricultural census is principally concerned with farmland and the occupiers of the 'farms' rather than owners of the farmland. The agricultural census is carried out through postal questionnaires. The main census was taken annually on

25 June until 1876 and subsequently on 4 June (Clark, 1982a). A number of censuses and surveys has been conducted from time to time. In addition to information on crops and livestock, questions have been added on land use (including non-agricultural land use), labour employed, trade in cattle and land tenure. The agricultural department on the basis of information on crops and livestock calculated a 'standardized man-day' (smd) for each agricultural holding between 1963 and 1980-81 (Clark, 1982a). The standard man-day weightings have been changed from time to time reflecting improvements in labour productivity. The minimum size to qualify as a full-time holding in 1980 was 275 smd for England and Wales, 250 for Scotland and 200 for Northern Ireland. To harmonize the British census with those of other member states of the EC, the standard man-day weightings have been replaced with standard gross margins (sgm).

Summaries of information have been made available to the public in different forms from time to time (e.g. Agricultural Statistics, England and Welsh Agricultural Statistics since 1978/9, Economic Reports on Scottish Agriculture since 1980). Information for areas smaller than counties is not published but parish summaries are available for consultation at the Public Record Office. Parish summaries contain information about crops, livestock, labour, land tenure and general land use.

There are some problems using parish summary data and summaries for county level. The data on administrative units are not useful as they may conceal considerable variations in farming within each area, for example, by combining upland and lowland areas. Clark (1992) argues that, although large administrative areas are more stable than smaller administrative units for the purpose of agricultural census, they can conceal variations in farming. On the other hand, small statistical units are more detailed than larger ones but difficulties may arise due to the changes in the farm size or administrative units.

The comparative value of the census is also impaired by changes in the way the census is structured. The census organisation may alter the questions it asks: new questions are included and old ones discarded. Clark (1992) has shown that a fundamental problem is with the definitions of 'farm', 'farmland' and the 'farmer'.

The difficulty arises because definitions vary from country to country, which makes international comparisons difficult, and they also vary over time within a single country, which impairs historical studies. The major difficulty in using the parish summaries is their lack of information on the fundamental unit of agricultural activity, the individual holding. Parish summary data represent only average conditions prevailing in the parish. The size of parishes varies considerably and so there is a wide variation in the degree of generalisation presented by the summaries for different parishes. Coppock (1965) suggests that a major problem concerns the lack of agreement between the civil parish and the 'agricultural parish'. The agricultural parish is a term applied because some farmland returned under a given parish may not lie wholly within the boundaries of that parish. The accuracy of parish summary data is another problem. Robinson (1988) identified two major sources of error in the agricultural returns: errors by farmers due to omission and underestimation or overestimation either deliberately or unintentionally, and errors by aggregators of mathematical or locational information.

Whereas the census gives an overview of agriculture, sectoral studies are concerned to provide in-depth analysis of a specific aspect of the industry. Valuable information is available in the UK from the Milk and Potato Marketing Boards. Moreover, the sector might also be an area of the country or a special type of a farm, such as crofting in Scotland. Clark (1992: 44) suggests that "the sector could be a theme running through farming, like structural change (USDA, 1981; OECD, 1972), land ownership (Northfield Committee, 1979) or tenure" (Gasson and Hill, 1984). Sectoral studies are carried out on a particular theme and in a particular way, facts which may not be useful for an agricultural geographer concerned with overall changes.

3.3.2 Other sources of data

For agricultural geographers, the most useful bibliographies are GeoAbstracts and World Agricultural Economic and Rural Sociology Abstracts. There are other bibliographies which are helpful to the agricultural geographer (e.g. Dissertation abstracts international; Index to theses with abstracts and current research in Britain); 'Valuable Guide to Official Statistics' (1980); 'Agriculture' by Peters, 1988; Monthly Catalogue of United States Government Publications; Australian Government Publications; Guide to the Official Publications of the European Communities, 1981; The Commission's Agricultural Statistics Yearbook; 'The Agricultural Situation in the Community'; Official Publications of Western Europe; Information Sources in Agriculture and Food science, 1981; 'The Annual Countryside Planning Yearbook' (since 1987 'The International Yearbook of Rural Planning': from 1991 this has been 'Progress in Rural Policy and Planning') (Clark, 1992). Many of these bibliographic sources have been used in this study.

3.3.3 Maps and field work

Clark (1992) has suggested five major categories of map types are useful to the agricultural geographer (physical, evaluation of environment, economic, production and processing and marketing). Although these maps provide basic information about the physical and human features of the earth's surface, they can also be used as a guide to detailed research, especially pertaining to land use and landscape studies. Maps also assist in providing guidelines for land use surveys carried out either by ground survey or aerial photography and remote sensing. Measurements of field shapes, sizes and boundaries, the number and orientation of communication links and the location of settlements can be obtained from an appropriate topographic map. The study of land use change can be carried out by comparing topographical maps of different dates within the limits of categories given on the map. Ordnance Survey (OS) maps at scale 1: 25,000 show field boundaries but maps at scale 1: 50,000 show only parish boundaries, woodland, settlement and communication patterns. Land use maps, such as the First and Second Land Use Surveys of Great Britain, classify land into types. Clark (1984) suggests that the method used to create classification is likely to affect the map of farming regions which is produced (see also Coppock 1976a, 1976b; Gregor 1982).

One major development from 1994 has been the availability of OS digital maps. The Ordnance Survey has successfully converted its maps into digital form at different scale based on different land use series. For example, its Land Line series covers Urban, Rural and Moorland areas at 1:1250, 1:2500 and 1:10,000 respectively.

Ordnance Survey maps (paper maps) at scale 1:25,000 were used in this study. They provide the location of the landscape features evaluated. These maps were used for two reasons: first, for interpreting the landscape features from aerial photographs, and, second, for measurements of linear and area features. They also helped to fix a common scale for measurement compared with aerial photographs of different scale. The process of measurement from maps (digitisation) was also simple and accurate compared with measurements from aerial photographs.

Field survey is the most important method for collecting information on farmers' attitudes, information on individual farm businesses and to research the processes operating within agriculture. As Clark (1992) suggests, available resources rarely permit a full census to be carried out. It is important to have a strategy which will provide a sample of data representative of the population from which it was drawn. This may require a complete and up-to-date list of all the farms in an area to form a sampling frame: this is rarely easy. Neither telephone directories nor electoral registers provide enough information, records of land ownership are at best imprecise guides to who controls farming when absentee landlords and renting land are prevalent, and lists of members of various rural groups are often incomplete, and confidentiality may any way limit their utility.

One way round these problems for a farm survey is to contact all the farms in an area using personal enquiry (Clark, 1992). A pattern of dispersed farms and farming settlements can make this method expensive. An alternative is postal survey. Response rates may be low, the non-response may bias the sample achieved and the illiterate cannot participate. A telephone survey is another option, but is only practicable if telephone numbers are available and the farmers willing to be interviewed. Surveys of people, however, are more problematic than map-based survey. Structured interviews provide standardised information from all the respondents. When the enquiry is about factual matters, this may be ideal. Research about respondents' attitudes, hopes, fears, opinions and their explanation for their action, may demand, however, a less structured approach with open-ended questions. If people's exact words, phrasing and intonation are important, then a tape recorder may be the best way of noting the results for later analysis. A pilot survey is always a helpful tactic in improving the efficiency of fieldwork methods and raising response rates.

Clark (1992) suggests that a large-scale postal survey can provide broad coverage of factual issues; this could be followed up by unstructured interviews with either a sample of respondents or with in-depth discussions with a handful of key decision-makers. The success of any strategy for field survey will depend on the balance between the sources it requires and the volume and quality of information it provides.

3.3.4 Remote sensing and aerial photographs

Remote sensing has two prominent characteristics which differentiate it from aerial photography: a large area can be measured in one image; satellites can 'revisit' an area of the earth's surface to make repeated observations. Remote sensing has been used to investigate the land cover changes in a large area. The EC has recently evaluated the claims of subsidies, submitted by farmers, using satellite images.

There are two major disadvantages of remote sensing in land use studies. First, even with the availability of very high resolution data i.e. 10 m, it does not provide detailed information about linear and point features of the agricultural landscape (e.g. field boundaries, farm buildings and trees), and this shortcoming makes it unsuitable for investigating landscape change. Second, the cost of remote sensing data is so high that it is expensive for individual researchers to carry out research based alone on remote sensed image. Aerial photographs are an important source of information for investigating changes in certain landscape features over time. They have been widely used and are of well proven value in land use studies. The interpretation of a particular land parcel or landscape object is evaluated on the basis of a given criteria, including size, shape, shadow, tone, texture, colour and pattern. Avery (1966) suggests that agricultural information that is often extracted from various types of aerial photography includes measurement of crop acreages, identification of specific crops or types of farming and analysis of significant changes in land use and landscape patterns. Seasonal changes in cropping can be followed, the movement of outdoor livestock can be traced, and the evolution of farmed landscape in terms of field boundaries and buildings can be recorded. The ability to measure historic change depends on the frequency of available photographic coverage. Parry's (1975) work on the changing altitudinal limits to cultivation was a notable example of such a study using aerial photographs. The most important factor which affects the details of an area is the scale of the photograph. The photographs at scale 1: 50,000 show fewer details of an area, especially about the point and linear features, than photographs at scale 1: 10,000. For land use and landscape studies, a scale of 1: 10,000 or less shows the post and wire fences of the field boundaries although there are some disadvantages due to the distortions in the aerial photographs caused by the tilt of the aircraft, variations in flying height and variations in ground altitudes (Dickinson 1979).

Accuracy depends on the scale of photographs and the resolution of a image. There have been claims of 75% and 95% accuracy (e.g. Collins and El-Beik, 1971) and most authors agree that certain land uses can be identified to a very high degree of accuracy whereas other elements are much more problematic. Nunnally and Witmer (1970) report considerable variations in accuracy between different interpreters of the same imagery. "Overall, it seems that many studies - provided they do not require over-great detail from their imagery and use trained personal - may regularly obtain accuracy of between 80% and 90% for those land uses which can be identified from air photography" (Rhind, 1980: 79).

For the purpose of this study, I used material produced by the Potato Marketing Board's aerial photographic surveys for parts of South East Scotland between 1972 to 1974. Use was also made of the aerial photographs carried out for Scotland as a whole in 1988 in the Royal Commission on Ancient and Historical Monuments of Scotland (RCAHMS). The Commission also has a large record of air photo plans of one square kilometre area for most parts of Scotland over different years on the scale 1: 2500.

This work thus stands alongside those studies of rural landscape (Barr et al, 1986; Bowers and Cheshire, 1983; Countryside Commission, 1984, CCS and NCC, 1988 and MLURI, 1992; Munton et al., 1987; Ward et al., 1985; Ward, 1991 and Westmacott et al. 1984) that have been carried out on the basis of aerial photographs.

3.4 METHODOLOGY

3.4.1 Choosing the study area

For the purposes of the agricultural census, the Department of Agriculture and Fisheries (DAF) defines South East Scotland as Tayside, Fife, Lothian and Borders regions. Before the Local Government Act (1973) for Scotland, the term was used by the DAF for the counties of Berwickshire, East Lothian, Mid-Lothian, West Lothian, Peeblesshire, Selkirkshire and Roxburghshire, all now districts of Lothian and Borders regions. Among the four regions of South East Scotland, Fife and Lothian are historically important agricultural areas producing cereals and other crops. The other two, Borders and Tayside, are well-known for livestock production. In the present study of agricultural land use changes from 1973 to 1990 only three regions - Fife, Lothian and Borders - are considered under the term South East Scotland and Tayside region is excluded because before 1973 it was not included in DAF's definition of South East Scotland and also because Tayside is quite different agriculturally from Lothian, Borders and Fife.

The selection of the sample areas for rural landscape change was based on a number of factors. South East Scotland has some of the best agricultural land in Britain available for studying landscape change. Most Scottish agricultural data are available in libraries in Edinburgh. Availability of the photographs was also an most important factor. The second set of aerial photographs (1988) was available in

Edinburgh, and the availability for a comparable area of the first set of aerial photographs determined potential sample areas. The sample area in East Lothian consisted of four civil parishes (Athelstaneford, Haddington, Morham, Prestonkirk). The second sample area, in Berwickshire, also consisted of four civil parishes (Ayton, Eyemouth, Bunkle and Preston, and Chirnside). The selection of two sample areas was necessary to investigate the rural landscape change for a number of reasons: to provide for more detailed landscape change in areas with some physical and agricultural differences, and to work with areas of manageable size and data. Figure 3.2 shows South East Scotland with the area covered by aerial photographs and field survey for the sample parishes selected given these criteria.

3.4.2 The methodology used for investigating agricultural change

One of the main objectives of this project is to investigate the effects at a parish level of agricultural change from 1973 to 1988 under the CAP. The proposed period of the study for agricultural change was from 1973 to 1993. Unfortunately, due to the non-availability of data for the years 1973 and 1993, the period of study was taken from 1972 to 1990.

Parish summary data was evaluated at four-year intervals from 1972 to 1990 (1972,1976,1980,1984,1988,1990). The last interval was two years because of the non-availability of 1992 parish summary data.

Agricultural statistics were divided into two major categories with further subcategories. The first category included the area under agricultural land, grass, rough grazing, tillage, cereal crops and farm labour. The second category was farm livestock including the total number of cattle, beef, sheep, pigs and poultry.

3.4.3 The methodology used in examining rural landscape change

The first aspect of the methodology was the selection of sample areas. This was based on the availability of aerial photographs. The Potato Marketing Board for

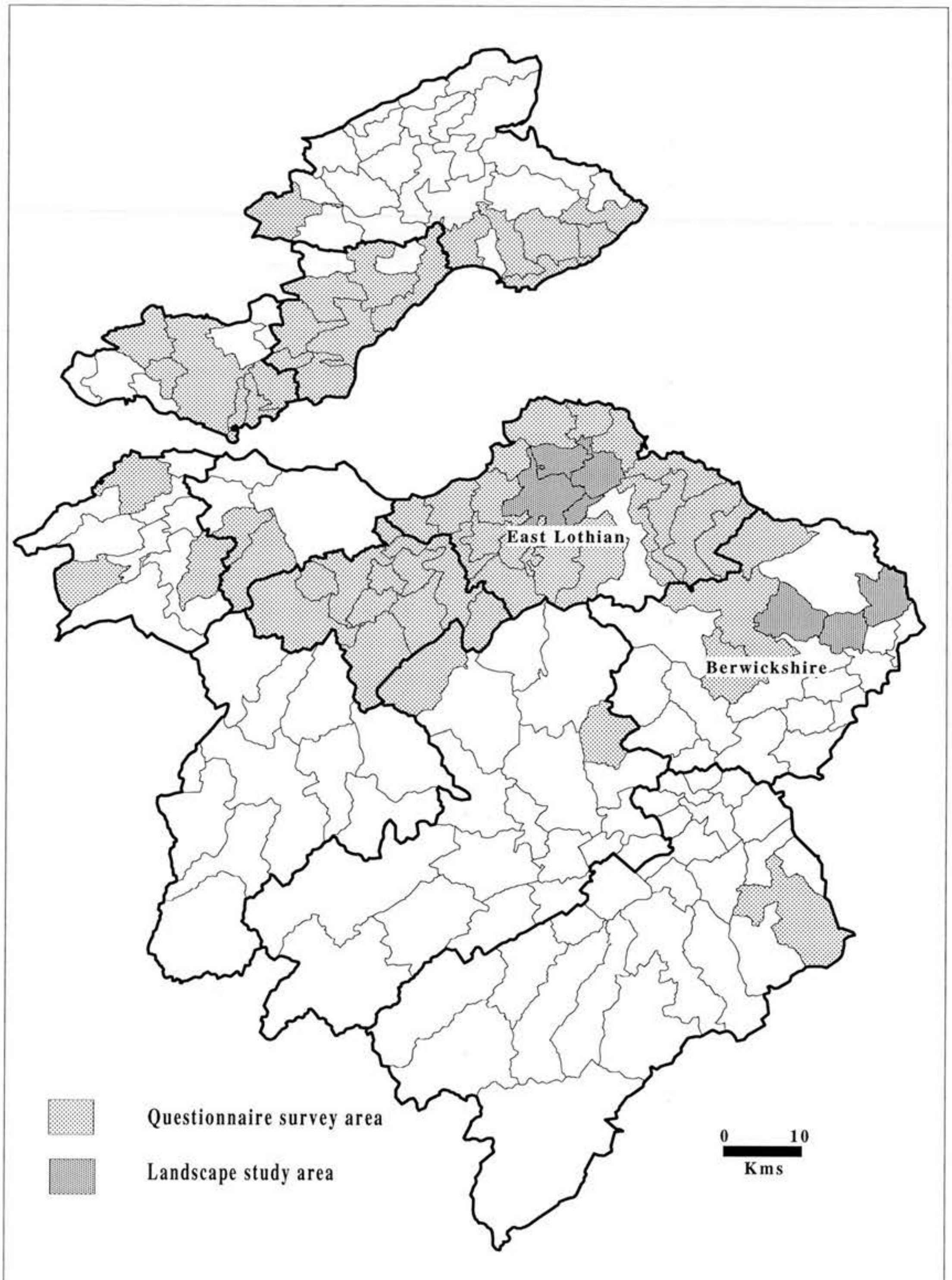


Fig. 3.2 Study area for questionnaire survey and landscape study

Scotland (PMBS) had some aerial photography of some parts of Lothian and Borders regions for its own research purposes in 1972 and 1974. The Regional Director in Edinburgh of the PMBS generously donated these photographs for this project. Two sample areas, one in East Lothian and one in Berwickshire, were selected based on these photographs. These photographs cover about 100 km^2 area of East Lothian around Haddington and adjoining civil parishes, and about 120 km^2 for Berwickshire district around Eyemouth, Ayton and adjoining parishes.

The second step was organising the study of these sample areas with a focus on landscape change. The study of agricultural change was based on civil parishes. What follows examines landscape change through the unit of civil parishes. According to the availability of aerial photographs for selected sample areas, four civil parishes (Haddington, Athelstaneford, Prestonkirk, Morham) in East Lothian and four civil parishes (Eyemouth, Ayton, Bunkle & Preston, and Chirnside) in Berwickshire district were selected. The total area of these parishes in East Lothian is around 80 km^2, and in Berwickshire approximately 70 km^2. A second set of aerial photographs was used, taken by the Scottish Office for monitoring land cover change in Scotland in 1988 and carried out by the Macaulay Land Use Research Institute. Figure 3.3 represents the procedure for selection of landscape sample areas.

The second aspect of the methodology was the selection of landscape components (Table 3.1) to be examined. Four types of data were used to carry out this project. Aerial photographs taken in 1972/1974 and 1988 were used to recognise and investigate farm landscape features. The collection of landscape data was based on two factors: first, the study period under the CAP (since 1973) and, secondly, the availability of photographs for selected years. There was a wide range of possible features from only a few (Edinburgh University and NCC, 1988) to 123 (MLURI, 1992) depending upon the nature of the research project. The selection of the components of landscape change was based on aerial photographs, topographical maps and field survey. The interpretation and measurement of field size and field boundaries was carried out using aerial photographs and topographical maps. Selected features were investigated via field survey (Figure 3.4).

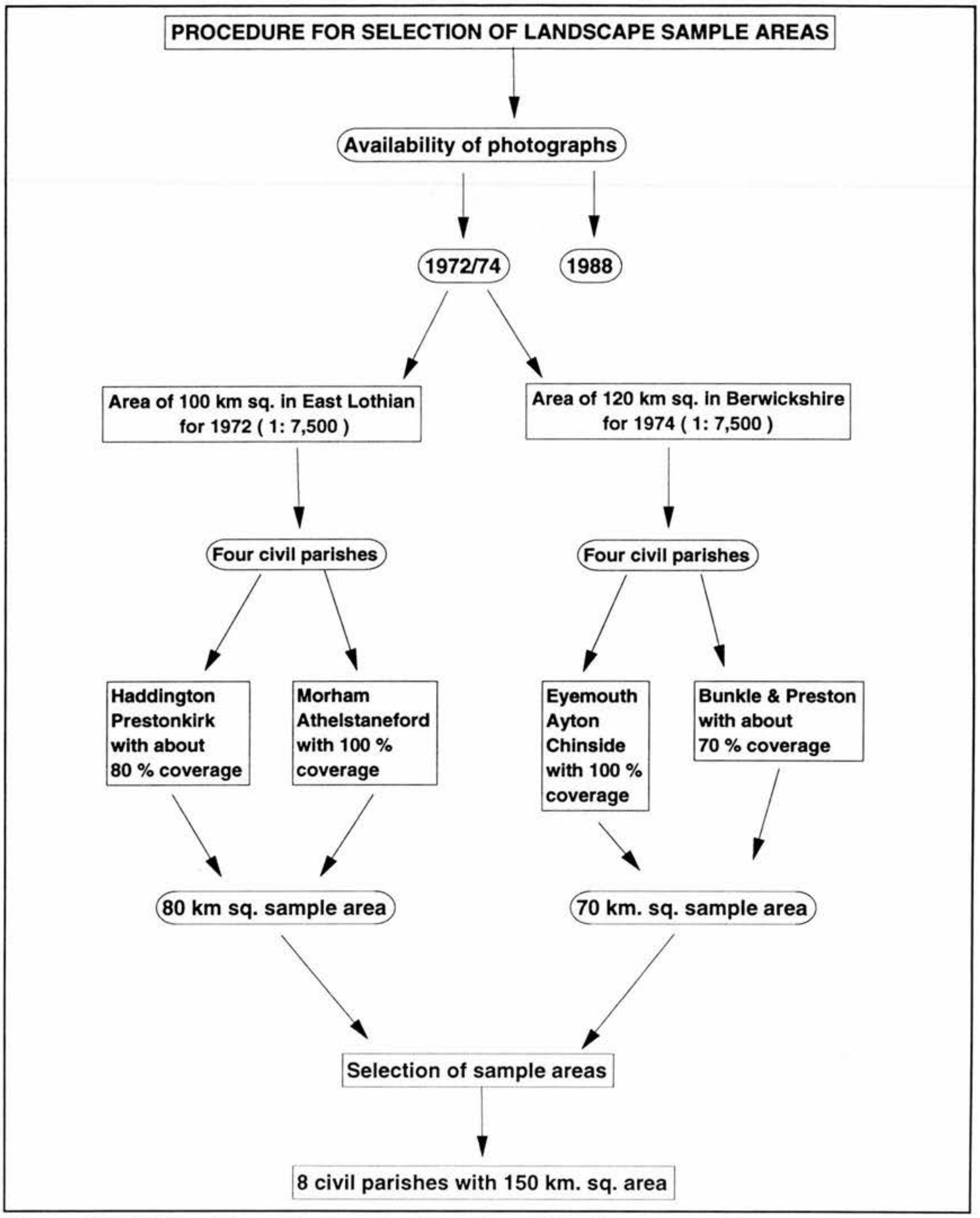


Figure 3.3 Methodology for the selection of rural landscape sample areas

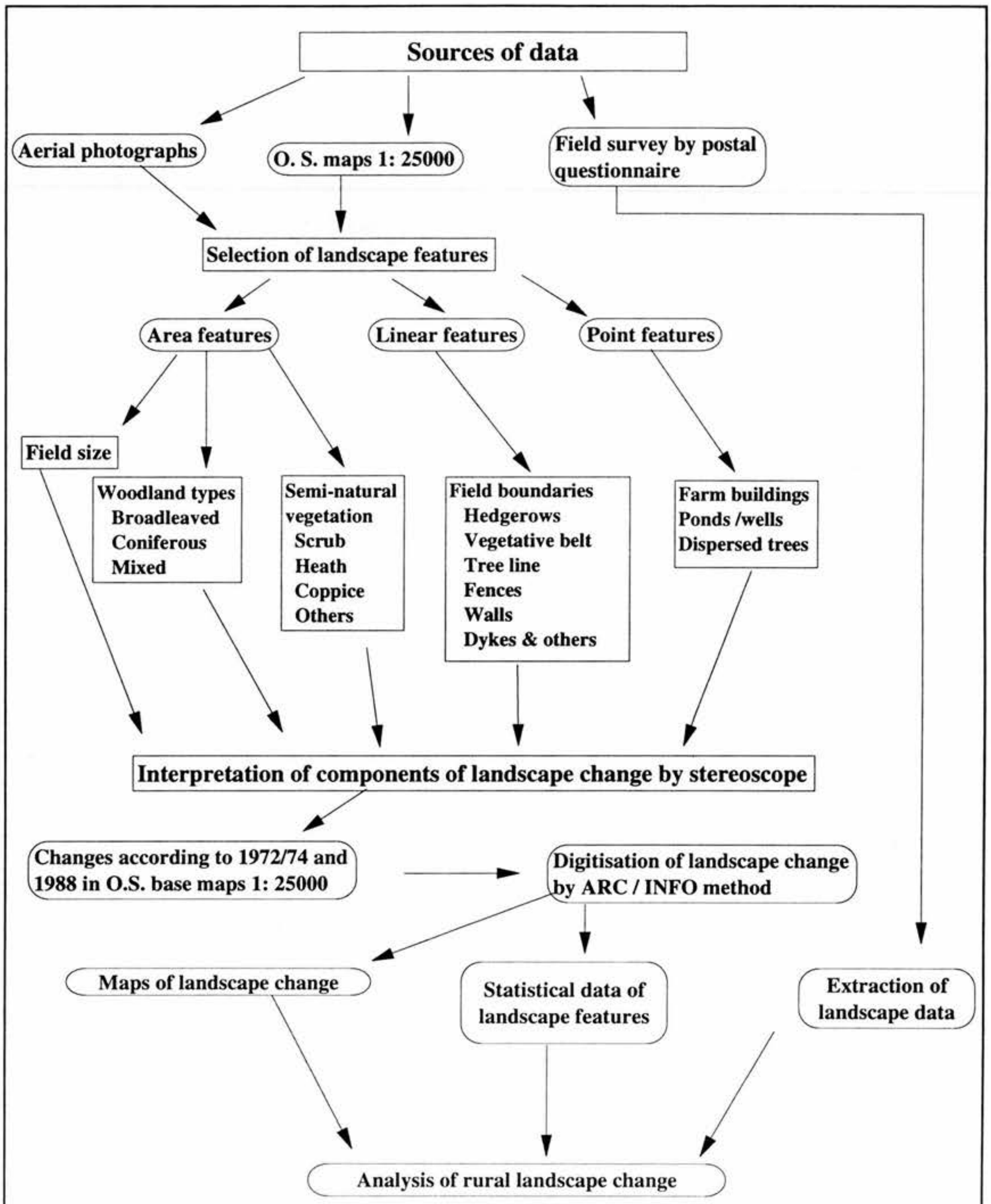


Figure 3.4 Methodology for rural landscape change analysis

Table 3.1 Components of the rural landscape utilised in the study

Field size		
Field boundaries		
	Hedgerows	All types of hedgerows planted as a field boundary
	Vegetative belt	Field boundaries other than hedgerow in the form of woodland fringe, riparian belts and any other form of vegetative belt
	Tree line	A continuous line of trees in the form of a field boundary
	Post & wire (fence):	All post & wire types of field boundary including roadside fences
	Stone wall	Clearly visible stone walls present in the form of field boundaries
	Dykes (Ditches) & others	Field boundaries including ditches and others e.g. mounds and hillside etc. and any other boundary which was present on the map but was unrecognisable from aerial photographs.
Farm features		
	Farm buildings	Excluding residential buildings
	Ponds and wells	
	Dispersed trees	
Farm woodland	**Coniferous, 2) Broad-leaved, and 3) Mixed woodland**	
Semi-natural vegetation		All types of semi-natural vegetation present on the Ordnance Survey maps as semi-natural vegetation

Topographical maps at scale 1: 25,000 were used as base maps because they show a number of farm landscape features including field boundaries, roads, paths, farm buildings, woodland, natural and semi-natural vegetation, and ponds and wells. To analyse field size and change in field boundaries, field boundaries were identified on topographical maps. Farm features were analysed on the basis of field survey data. The presence and types of field boundaries were recognised from aerial photographs and marked on the topographical maps. New field boundaries were drawn on the maps using Sketch master (a photogrammetric instrument made for this purpose), where needed. Figure 3.4 represents the procedure for analysis of landscape change.

A number of methods for measurements of landscape features were available (Dickinson 1979), including the methods of digitising and point counting used by the CCS and NCC (1989), and the Edinburgh University and NCC (1988) in their studies. Maling (1989) has examined these methods of measurements. The measurement and analysis of landscape components in this present study was performed using Arc/Info GIS.

GIS is a computer-based system of integrating spatially-referenced information (both statistical and cartographic) and providing facilities for the editing, combining, processing, analysing and display of that information. All landscape features, marked on the base maps, were digitised using ARC/INFO. After converting map data into digital form, data were edited accordingly using Arcedit. The data were analysed using ARC/INFO. The statistical data were acquired and manipulated under the INFO database. Maps of landscape change were then produced using Arcplot.

Data about point features (ponds, wells, trees) and removal of field boundaries were extracted from the questionnaire survey. Data about the participation of farmers in different schemes offered by the government were also extracted to support the results of landscape change in the sample areas.

3.4.4 The methodology for field survey

A postal questionnaire survey was carried out. The study area for the survey was based on the sample areas for landscape change. Due to the non-availability and confidentiality of the addresses of farmers, a request was made to the Scottish Agricultural College (SAC) for help. A total of 600 questionnaires was sent to farmers by the Scottish Agricultural College in Lothian and Fife regions, focusing upon the landscape sample areas. The response rate was about 50% (285 questionnaires).

3.5 PROBLEMS OF DATA COLLECTION AND OPERATIONAL METHODOLOGY

Two major problems were faced in connection with data collection: first, availability of parish summary data, and second, non-availability of aerial photographs for landscape sample areas. Parish summary data were available in Register House, Edinburgh. The second option was utilising information in the Data Library of Edinburgh University, which holds agricultural data for some years. Data in both Register House and in the Data Library were available up to 1990. Keeping in view the time available for this project, it was decided that data would be used for the years 1972, 1976, 1980, 1984, 1988 and 1990.

A further problem arose in connection with landscape sample areas. There were no OS aerial photographs easily available for the years and areas selected. A related issue was that of the cost of aerial photographs for the study areas. The Royal Commission on Ancient and Historical Monuments of Scotland (RCAHMS) had aerial photographs for 1988 and the problem of an earlier set of aerial photographs was solved by the donation of aerial photographs by the Potato Marketing Board.

3.6 SUMMARY

The chapter opened by outlining data sources available for studying agricultural change. Agricultural returns are the most important source for studying agricultural change despite limitations. They are also easily available. Maps and field work (questionnaire survey) are other sets of data used in this study. Maps provide some important information dependent on their scale and purpose. Field survey is the most important source of collecting information on aspects of agricultural change, although there are problems in investigating the nature of landscape change using such methods. Remote sensing and aerial photographs are the most advanced techniques which can be used in investigating land use and landscape change. Aerial photographs are used here in investigating the landscape change.

Agricultural returns have been used to investigate agricultural change in the study area. To investigate rural landscape change two sample areas were selected on the basis of availability of aerial photographs. These sample areas differ in their nature due to the relief characteristics and nature of agriculture in the areas. The examination of landscape features is undertaken here through the integrated approach of maps, aerial photographs and field survey and Arc/Info GIS was used to measure and evaluate the components of landscape change from maps and aerial photographs.

In the next chapter the first objective of this project, to investigate agricultural change in the study area (South East Scotland), is evaluated. Before analyzing agricultural change a review of the physical basis (topography, soil and climate) of the study area is described. Agricultural change at parish level along with summaries at district level is analyzed between 1972 to 1990 at selected time intervals to see the changing cropping and livestock patterns under the CAP.

CHAPTER 4

AGRICULTURAL CHANGE, 1972 - 1990

4.1 INTRODUCTION

The basic aim of this chapter is to examine those agricultural changes occurring during the period 1973 to 1990 under the influence of the CAP. The material is reviewed for 1972 to 1990 given the availability of parish summary data. Major components of agricultural change (major crops and livestock elements) are examined emphasising the spatial patterns of agricultural change in the parishes. Questionnaire survey data for South East Scotland is also examined to explore the linkages between the farmers, agricultural change and the CAP.

4.2 AGRICULTURAL CHANGE

"The characteristics of agricultural industrialisation include the creation of scale economies at the farm level (large farms), the increased reliance on the purchased inputs from the sectors of the economy (machinery, fertiliser, feed, agrochemicals), resource substitution (capital for land and labour), the implementation of organisational features associated with the concept of the 'firm', specialization of the labour function within the farm business and mechanization of the production process" (Bowler, 1992: 13). The CAP has played an important role in the intensification of agriculture. Major agricultural changes have occurred in the UK since 1973 under the CAP (Robinson, 1988). They include technological advances, high production, changes in farming structure, socio-economic changes and changes in agricultural trade within the EC (Bowler, 1985). These changes have affected the full range of agricultural activities, from changes in cropping patterns and land use to farm size structures, the nature of agricultural production and the socio-economic conditions of farmers. The major impact has been upon overall production. For example, during the 1970s, cereal output in Britain rose by 24 per cent while the sales of milk off farms increased by 33 percent (Robinson, 1988). The level of self sufficiency in percentage terms in the United Kingdom in 1980 was 80 (wheat), 116 (barley), 95 (potatoes), 46 (sugar), 77 fresh vegetables, 77 (beef and veal), 63 (pigmeat), 100 (poultrymeat), 74 (milk), 99 (eggs) and 61 (sheepmeat) (Bowler, 1985). The study area (South East Scotland) comprised 11 districts and 199 civil parishes. These civil parishes have been amalgamated by the MAFF for Agricultural Returns purposes in different years. In this study, after reviewing these amalgamations, parishes were amalgamated from 199 to 175 in order to produce an accurate and coherent picture of agricultural change in the study area (e.g Figure 1.1). Figure 4.1 shows the land capability for agriculture in these civil parishes. Table 4.1 presents in summary those agricultural changes occurring in South East Scotland between 1972 and 1990.

Table 4.1 Land use changes in South East Scotland

	Area in (ha) 1972	Area in (ha) 1990	% change 1972-1990	% of total area in 1972	% of total area in 1990
Total area of land	642099.7	607935	-5.32	-	-
Farm holdings	4116	3542	-13.95	-	-
Average farm size[1]	-	-	-	84.49	101.10
Area rented from outside	226568.1	188020.8	-17.01	35.29	30.93
Area rented from relative	59747.6	91345.6	52.89	9.31	15.03
Area owned	355784	328568.6	-7.65	55.41	54.05
Agricultural land[2]	347748.5	358102.6	2.98	54.16	58.90
Rough grazing	278744.7	229917.5	-17.52	43.41	37.82
Woodland	11687.3	16353.4	39.92	1.82	2.69

1 Average farm size for agricultural land
2 Includes crops, follow and grass
Source: computed from parish summary data

The total area of land has decreased from 642,099 ha to 607,935 ha (-5.32%) between the period 1972-1990. The total number of farm holdings has decreased from 4116 to 3542 (-13.95%), a decrease of 574 farm holdings. The decrease is due to changes in land tenure and reflects also the nature of changing farm size structure,

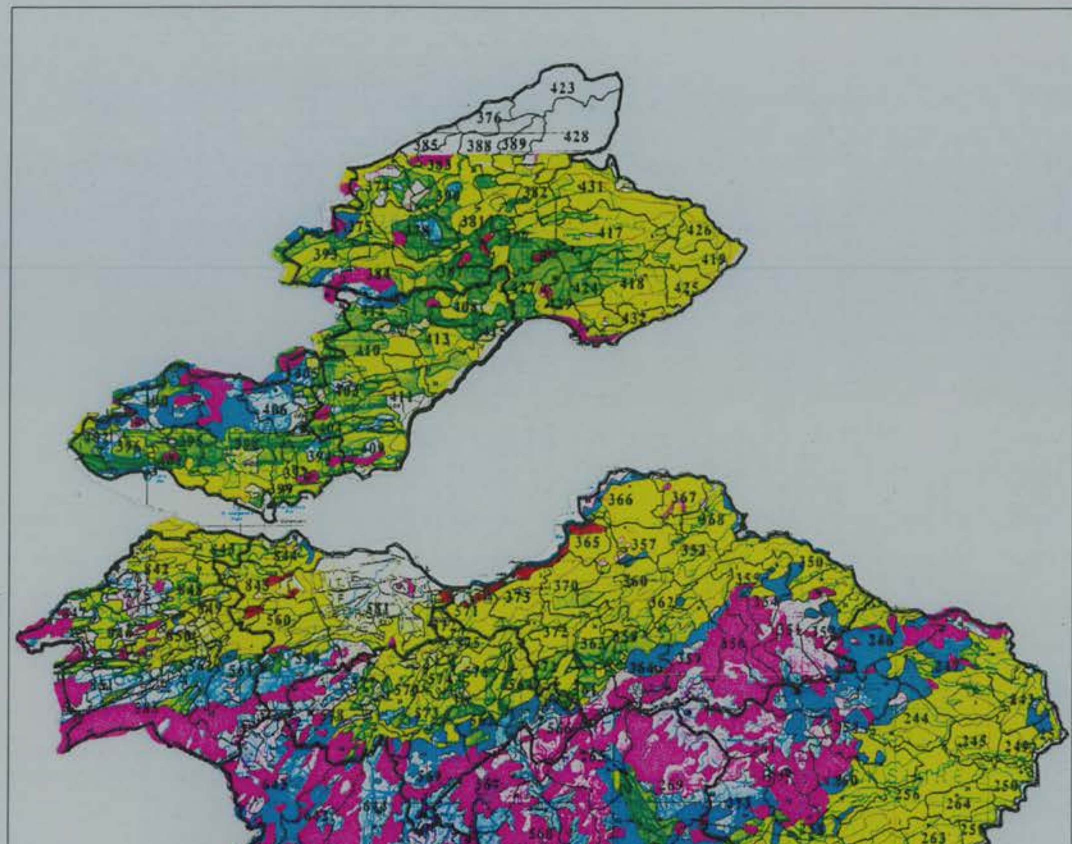


Figure 4.1 Land capability for agriculture in South East Scotland

Figure 4.1 (continued)

LAND CAPABILITY FOR AGRICULTURE

CLASS DESCRIPTIONS		DIVISION DESCRIPTIONS
LAND SUITED TO ARABLE CROPPING		
LAND CAPABLE OF PRODUCING A VERY WIDE RANGE OF CROPS Cropping is highly flexible and includes the more exacting crops such as winter harvested vegetables (cauliflower, brussels sprouts, leeks). The level of yield is consistently high. Soils are usually well-drained deep loams, sandy loams, silty loams or their related humic variants with good reserves of moisture. Sites are level or gently sloping and the climate is favourable. There are no or only very minor physical limitations affecting agricultural use.	1	Not divided
LAND CAPABLE OF PRODUCING A WIDE RANGE OF CROPS Cropping is very flexible and a wide range of crops can be grown but the land may be unsuited to winter harvested crops. The level of yield is high but less consistently obtained than on Class 1 land due to the effects of minor limitations affecting cultivation, crop growth or harvesting. The limitations include, either singly or in combination, slight workability or wetness problems, slightly unfavourable soil structure or texture, moderate slopes or slightly unfavourable climate. The limitations are always minor in their effects and land in the class is highly productive.	2	Not divided
LAND CAPABLE OF PRODUCING A MODERATE RANGE OF CROPS Land in this class is capable of producing good yields of a narrow range of crops, principally cereals and grass, and/or moderate yields of a wider range including potatoes, some vegetable crops (e.g. field beans and summer harvested brassicae) and oil seed rape. The degree of variability between years will be greater than is the case for Classes 1 and 2, mainly due to interactions between climate, soil and management factors affecting the timing and type of cultivations, sowing and harvesting. The moderate limitations require careful management and include wetness, restrictions to rooting depth, unfavourable structure or texture, strongly sloping ground, slight erosion or a variable climate. The range of soil types within the class is greater than for previous classes.	3_1	Land in this division is capable of producing consistently high yields of a narrow range of crops (principally cereals and grass) and/or moderate yields of a wider range (including potatoes, field beans and other vegetables and root crops). Short grass leys are common.
	3_2	This land is capable of average production but high yields of barley, oats and grass are often obtained. Other crops are limited to potatoes and forage crops. Grass leys are common and reflect the increasing growth limitations for arable crops and degree of risk involved in their production.
LAND CAPABLE OF PRODUCING A NARROW RANGE OF CROPS The land is suitable for enterprises based primarily on grassland with short arable breaks (e.g. barley, oats, forage crops). Yields of arable crops are variable due to soil, wetness or climatic factors. Yields of grass are often high but difficulties of production or utilisation may be encountered. The moderately severe levels of limitation restrict the choice of crops and demand careful management. The limitations may include moderately severe wetness, occasional damaging floods, shallow or very stony soils, moderately steep gradients, moderate erosion risk, moderately severe climate or interactions of these which increase the level of farming risk.	4_1	Land in this division is suited to rotations which, although primarily based on ley grassland, include forage crops and cereals for stock feed. Yields of grass are high but difficulties of utilisation and conservation may be encountered. Other crop yields are very variable and usually below the national average.
	4_2	The land is primarily grassland with some limited potential for other crops. Grass yields can be high but difficulties of conservation or utilisation may be severe, especially in areas of poor climate or on very wet soils. Some forage cropping is possible and, when the extra risks involved can be accepted, an occasional cereal crop.
LAND SUITED ONLY TO IMPROVED GRASSLAND AND ROUGH GRAZINGS		
LAND CAPABLE OF USE AS IMPROVED GRASSLAND The agricultural use of land in Class 5 is restricted to grass production but such land frequently plays an important role in the economy of British hill lands. Mechanized surface treatments to improve the grassland, ranging from ploughing through rotavation to surface seeding and improvement by non-disruptive techniques are all possible. Although an occasional pioneer forage crop may be grown, one or more severe limitations render the land unsuitable for arable cropping. These include adverse climate, wetness, frequent damaging floods, steep slopes, soil defects or erosion risks. Grass yields within the class can be variable and difficulties in production and particularly utilisation are common.	5_1	Establishment of a grass sward and its maintenance present few problems and potential yields are high with ample growth throughout the season. Patterns of soil, slope or wetness may be slightly restricting but the land has few poaching problems. High stocking rates are possible.
	5_2	Sward establishment presents no difficulties but moderate or low trafficability, patterned land and/or strong slopes cause maintenance problems. Growth rates are high and despite some problems of poaching satisfactory stocking rates are achievable.
	5_3	Land in this division has properties which lead to serious trafficability and poaching difficulties and although sward establishment may be easy, deterioration in quality is often rapid. Patterns of soil, slope or wetness may seriously interfere with establishment and/or maintenance. The land cannot support high stock densities without damage and this may be serious after heavy rain even in summer.
LAND CAPABLE OF USE ONLY AS ROUGH GRAZINGS The land has very severe site, soil or wetness limitations which generally prevent the use of tractor-operated machinery for improvement. Reclamation of small areas to encourage stock to range is often possible. Climate is often a very significant limiting factor. A range of widely different qualities of grazing is included from very steep land with significant grazing value in the lowland situation to moorland with a low but sustained production in the uplands. Grazing is usually insignificant in the full arctic zones of the mountain lands, but below this level grazings which can be utilised for five months or longer in any year are included in the class. Land affected by severe industrial pollution or dereliction may be included if the effects of the pollution are non-toxic.	6_1	Land in the division has high proportions of palatable herbage in the sward, principally the better grasses, e.g. meadow grass-bent grassland, bent-fescue grasslands
	6_2	Moderate quality herbage such as white and flying bent grasslands, rush pastures and herb-rich moorlands or mosaics of high and low grazing values characterise land in the division.
	6_3	The vegetation is dominated by plant communities with low grazing values, particularly heather moor, bog heather moor and blanket bog.
LAND OF VERY LIMITED AGRICULTURAL VALUE This land has extremely severe limitations that cannot be rectified. The limitations may result from one or more of the following: extremely severe wetness, extremely stony rocky land, unvegetated soils, scree or beach gravels, toxic waste tips and dereliction, very steep gradients, severe erosion including intensively hagged peat lands, and extremely severe climates (exposed situations, protracted snow-cover and short growing season). Agricultural use is restricted to very poor rough grazing.	7	Not divided

and the fact that small holdings have been amalgamated to create larger farms. The average farm size has increased from 84.48 ha to 101.10 ha during this period. This reflects changes in the average farm size change in the area (+19.6% increase). Major changes have occurred in land tenure during this period. The area owned by farmers has decreased (-7.65%) and the area rented from outside (non-family) concerns has declined (-17.01%), but the area rented from near relatives has increased greatly (+52.89%). The area under agricultural land has slightly increased (+2.98%) from 54.16% of the total area in 1972 to 58.90% of the total area in 1990. This change in total agricultural land is mainly due to a decline of the total area and of the area under rough grazing. The change in rough grazing is -17.52%, in turn the result of an increase in the area under agricultural land and woodland. The area under farm woodland has increased from 11687 ha to 16353 ha (+39.92% change). Table 4.2 represents the changes in area under crops and grass.

Table 4.2 Changes in the area under major crops and grass in South East Scotland, 1972 - 1990

	Area in (ha) 1972	Area in (ha) 1990	% change 1972-1990	% of agricultural land in 1972	% of agricultural land in 1990
Wheat	16682.4	53059.7	+218.06	4.80	14.82
Barley	96610.1	87857.1	-9.06	27.78	24.53
Oats	17673.2	4879.6	-72.39	5.08	1.36
Oilseed rape[1]	4834	15538.8	+321.45	0.00	4.34
Potatoes	6577.2	4439.4	-32.50	1.89	1.24
Cereals[2]	130965.7	145796.4	+11.32	37.66	40.71
Tillage	163994.6	190811.8	+16.35	47.16	53.28
Grass for mowing	46805.3	43558.7	-6.94	13.46	12.16
Grass for not mowing	135930.4	119551.9	-12.05	39.09	33.38

[1] **First sown in 1984**
[2] **Includes wheat, barley and oats**
Source: computed from parish summary data

High increase is evident in wheat (+218.06%) and in oil seed rape (+321.45%). The greatest decrease (-72.39%) has occurred in oats production. There has also been a decline in the area under barley, potatoes and grass. The total area under tillage (+16.3%) and in cereals (including wheat, barley and oats) has increased. This increase in the area under cereals is due mainly to very high increase in areas under wheat. Table 4.3 shows the changes in farm livestock in South East Scotland.

Table 4.3 Changes in farm livestock in South East Scotland, 1972 - 1990

	Numbers in 1972	Numbers in 1990	% change 1972-1990	Density per 100 ha of agricultural land in 1972	Density per 100 ha of agricultural land in 1990
Dairy cattle	59694	26632	-55.39	17.17	7.44
Beef cattle	255943	237478	-7.21	73.60	66.32
All cattle	315637	264110	-16.32	90.77	73.75
All Sheep	1495299	1897097	26.87	429.99	529.76
All pig	110185	84423	-23.38	31.69	23.58
All poultry	5951807	5838370	-1.91	1711.53	1630.36

Source: computed from parish summary data

All farm livestock production except sheep has decreased between 1972 and 1990. The increase in sheep production has been accompanied by a change in density per 100 ha of agricultural land from 430 sheep/ha in 1972 to 530 in 1990. Dairy cattle has the highest reduction (-55.39%). The reduction of dairy cattle is mainly due to changes in milk prices and the introduction of the quota system implemented since 1984.

The changing patterns of land use and farm livestock for different years during this period can be seen in Figure 4.2 which shows the index numbers of agricultural change based on 1972.

4.2.1 Land Tenure

Change in land tenure has occurred largely through a decrease in farm holdings and for reasons to do with family transfer, amalgamation of farms, and farmers leaving the industry. There has been a decrease (-7.65%) in the area owned by farmers and in the area rented from outside concerns (-17.01%). An increase (+52.89%) in areas rented from near relatives is apparent (Table 4.1). Figure 4.3 shows the changes in farm holdings in South East Scotland. Two distinctive patterns are clearly visible. First, there has been a decline in the numbers of farm holdings in all districts between 1972-1988, and, second, farm holdings have increased in almost

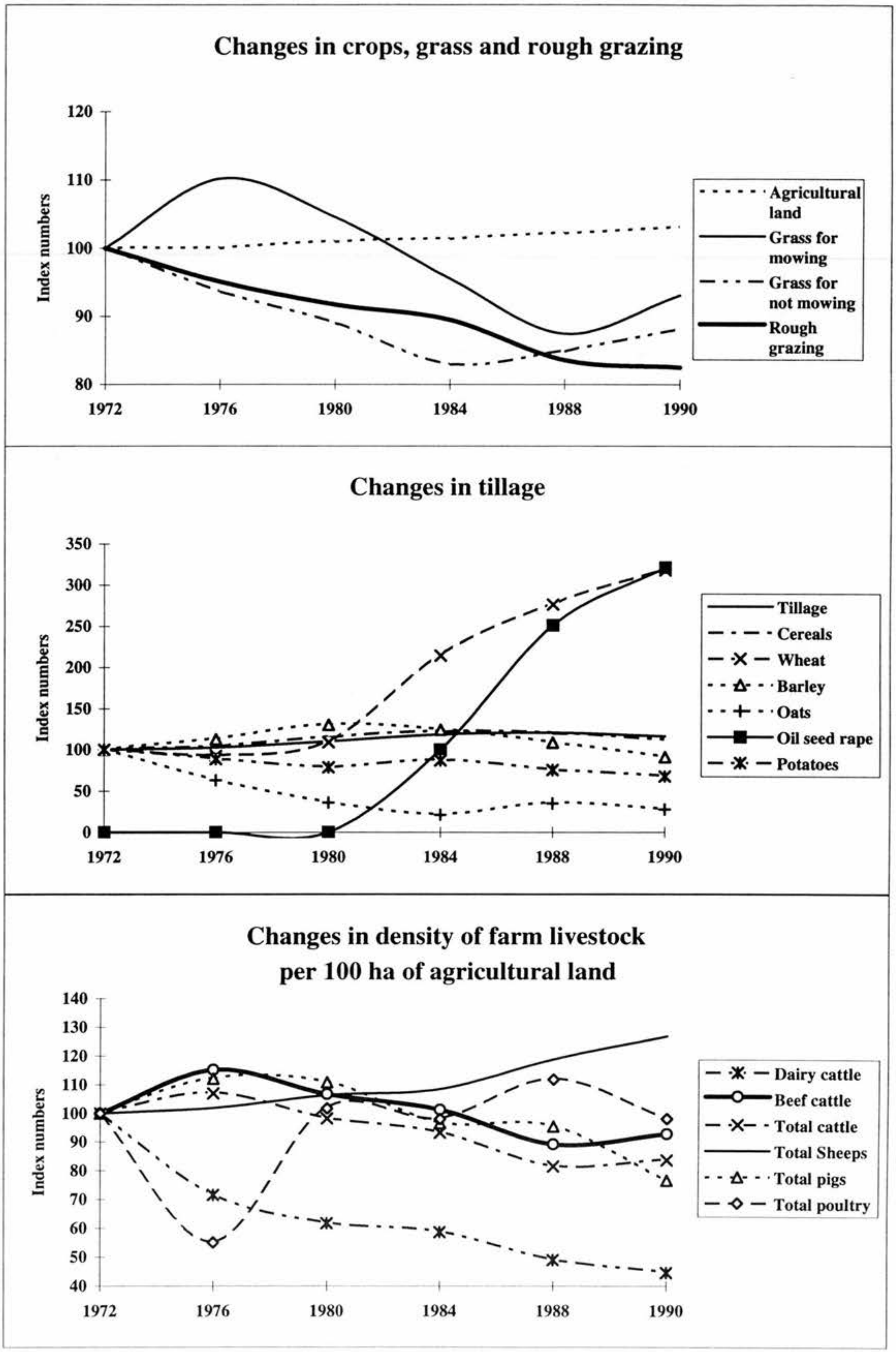


Figure 4.2 Index numbers of agricultural change in South East Scotland

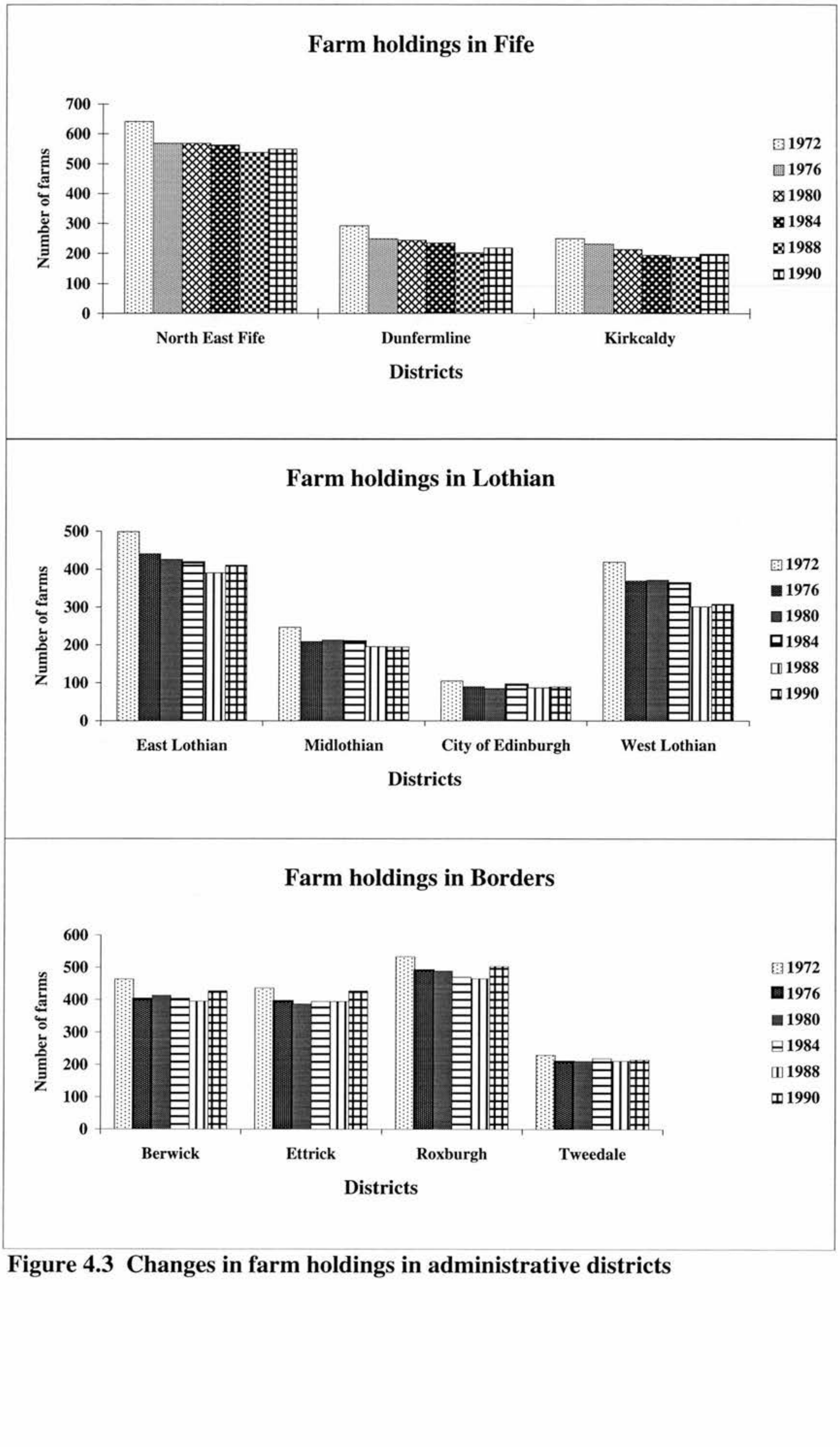


Figure 4.3 Changes in farm holdings in administrative districts

all districts by 1990. This change reflects the fact that the change in the CAP's price and structural policies has forced the farmers to adopt different ways of income support such as sale of farm land, dividing their land within family members, and renting the land. Figure 4.4 presents the percentage changes in land tenure at parish level in South East Scotland. In spite of an overall increase in farm holdings between 1988 and 1990, this evidence suggests a general decline in farm holdings (up to 70% decline) in most parishes. Another trend is an increase (up to +40%) of farm holdings in some parishes, a trend due to an increase of farm holdings between 1988 and 1990, where a minor increase in total number of farm holdings, are already small in number, can change the patterns greatly.

There have been great changes in land tenure patterns in all parishes. Parishes in Fife and Lothian regions have a general trend of increase (up to +25%) in the area owned by farmers. Borders region, which mostly produces livestock, has a decrease (up to -50%) in most parishes. The area rented from outside concerns has decreased in almost all parishes; only a few parishes have increased their area. The highest percentage changes have occurred in the area rented from near relatives. The highest percentage changes (more than 500%) have occurred in a major part of the Borders region, Midlothian and in North-East Fife: areas best suited for farm livestock production. The land tenure change has two contrasting patterns: areas owned by the farmers have increased in crop-producing parishes while areas rented from near relatives have increased in livestock-producing parishes. These patterns suggest that most arable farmers have bought land from others willing to leave the agricultural practice (either because of the small area of their land or because landlords have been taking back their land from tenants to bring under their own management). This is also reflected through the decline in the number of farm holdings in the parishes. On the other hand, in livestock-producing parishes, farmers preferred to rent their land to their relative instead of leaving the agricultural practice (Bowler, 1985). Figure 4.5 shows the average farm size change based on agricultural land at district level. Most of the districts have a trend of an increase in average farm size in all districts from 1972-1988. A decrease in average farm size occurred between 1988

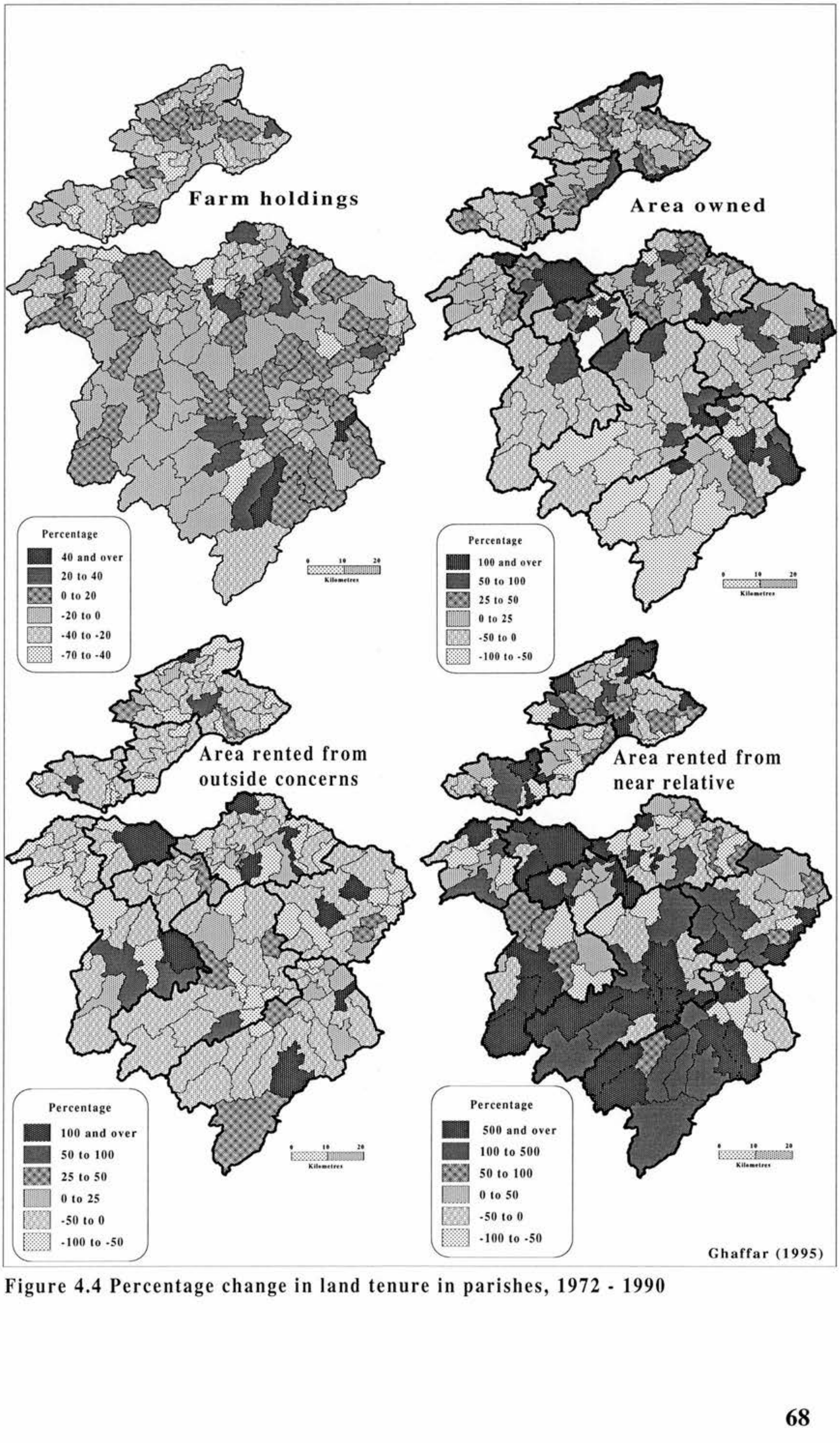


Figure 4.4 Percentage change in land tenure in parishes, 1972 - 1990

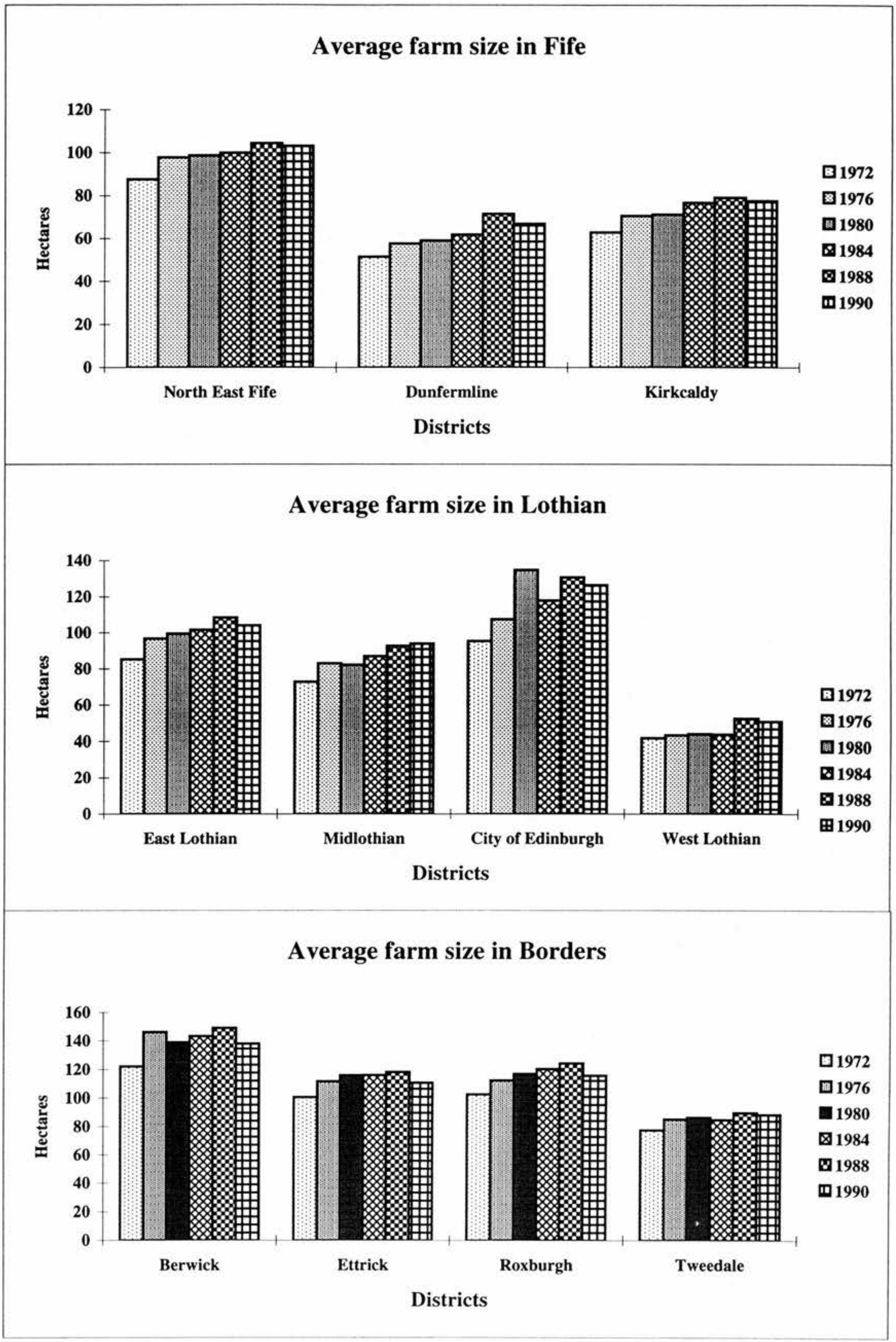


Figure 4.5 Average farm size in administrative districts

and 1990, a fact due to an increase of farm holdings in the area (see Figure 4.3). Although the Borders region has variations in average farm size, there is a general trend of increase in average farm size. The largest farms are found in Berwickshire (more than 150 ha). The smallest farms are in West Lothian and Dunfermline districts. Figure 4.6 presents the changes in farm holdings and in average farm size at parish level. A decrease of farm holdings can be observed. The average farm size has increased especially in North-East Fife, Berwickshire and Roxburghshire. All these districts have the best arable land (see Figure 4.1) in South East Scotland. An increase can also be observed in Tweeddale district. A decrease in average farm size has occurred only in a few parishes which is probably due to an increase of farm holdings in 1990. The change in farm holdings has resulted in a change of farm size in the area. The Farm Amalgamation Scheme (1973) and the Farm Structure (Payments to Outgoers) Scheme (1976) have encouraged older farmers to leave agriculture. Although these schemes have not been popular with the farmers as the suggested by Bowler (1985), these schemes along with other factors such as the small area of farms have been playing an important role in leading to the decrease of farm holdings, and therefore to an increase in the average farm size in the area. The sudden increase of farm holdings since 1988 is because of the Farm Diversification Scheme (1988) and the Set Aside Scheme (1988) under which emphasis has been given to conversion of productive agricultural land into non-arable purposes. Bowler (1992) noted that farmers have been selling some of their land as 'hobby farms' to urban migrants. It may also be hypothesised that this is due to the transfer of land to other family members because of inheritance.

4.2.2 Changes in Crops, grass and rough grazing

The total area under tillage has increased in South East Scotland from 163, 994 ha to 190, 811 ha (+16.35% change) between 1972 and 1990. The percentage of tillage has risen from 47.16% to 53.28% (see Table 4.2). Figure 4.7 describes the percentage changes in the area under crops, grass and rough grazing at parish level. A higher percentage change in tillage (under +50%) is widely evident through almost the whole of Fife, East Lothian, Midlothian, Berwickshire, and in major parts of

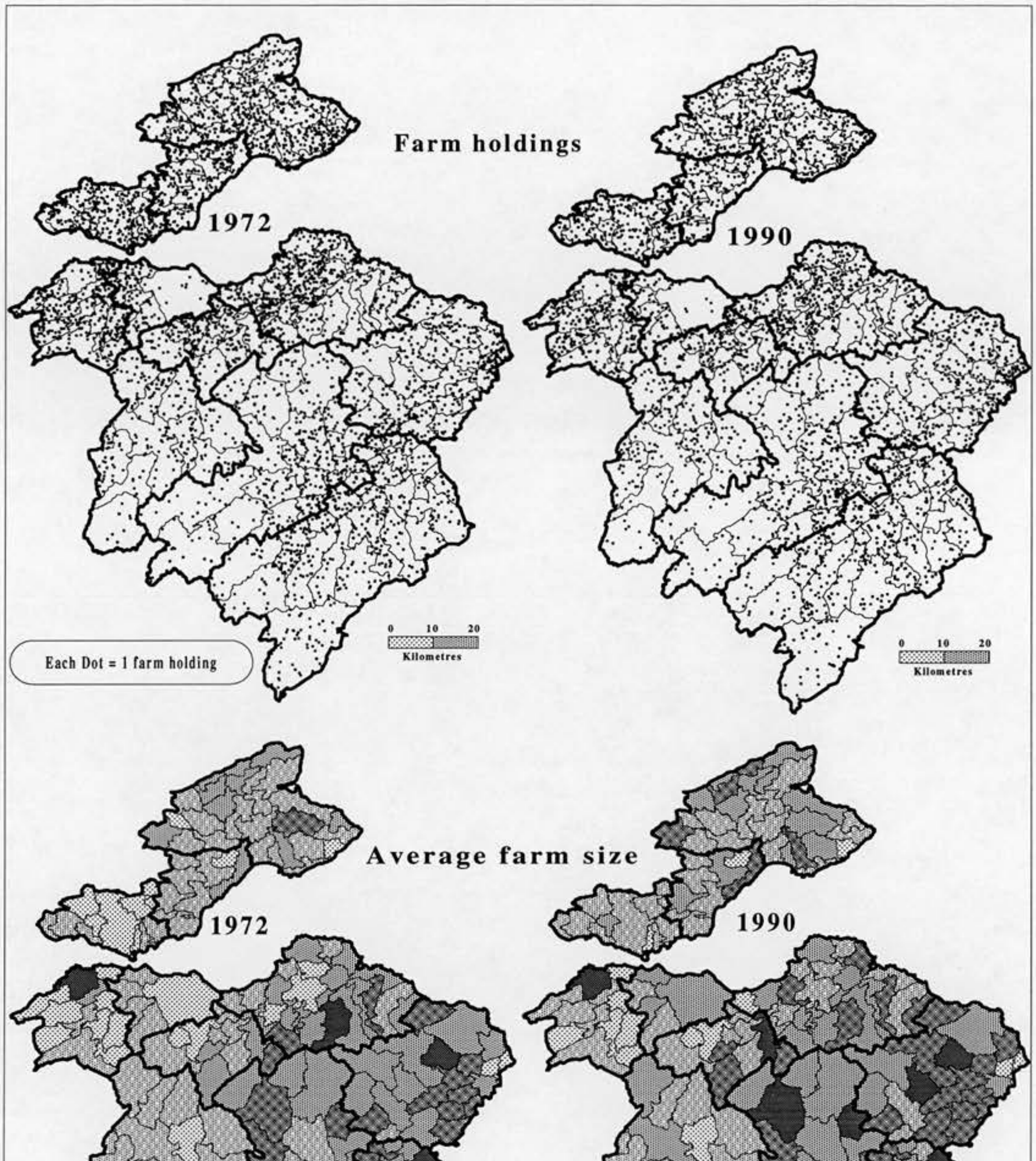


Figure 4.6 Changes in farm size stucture, 1972 - 1990

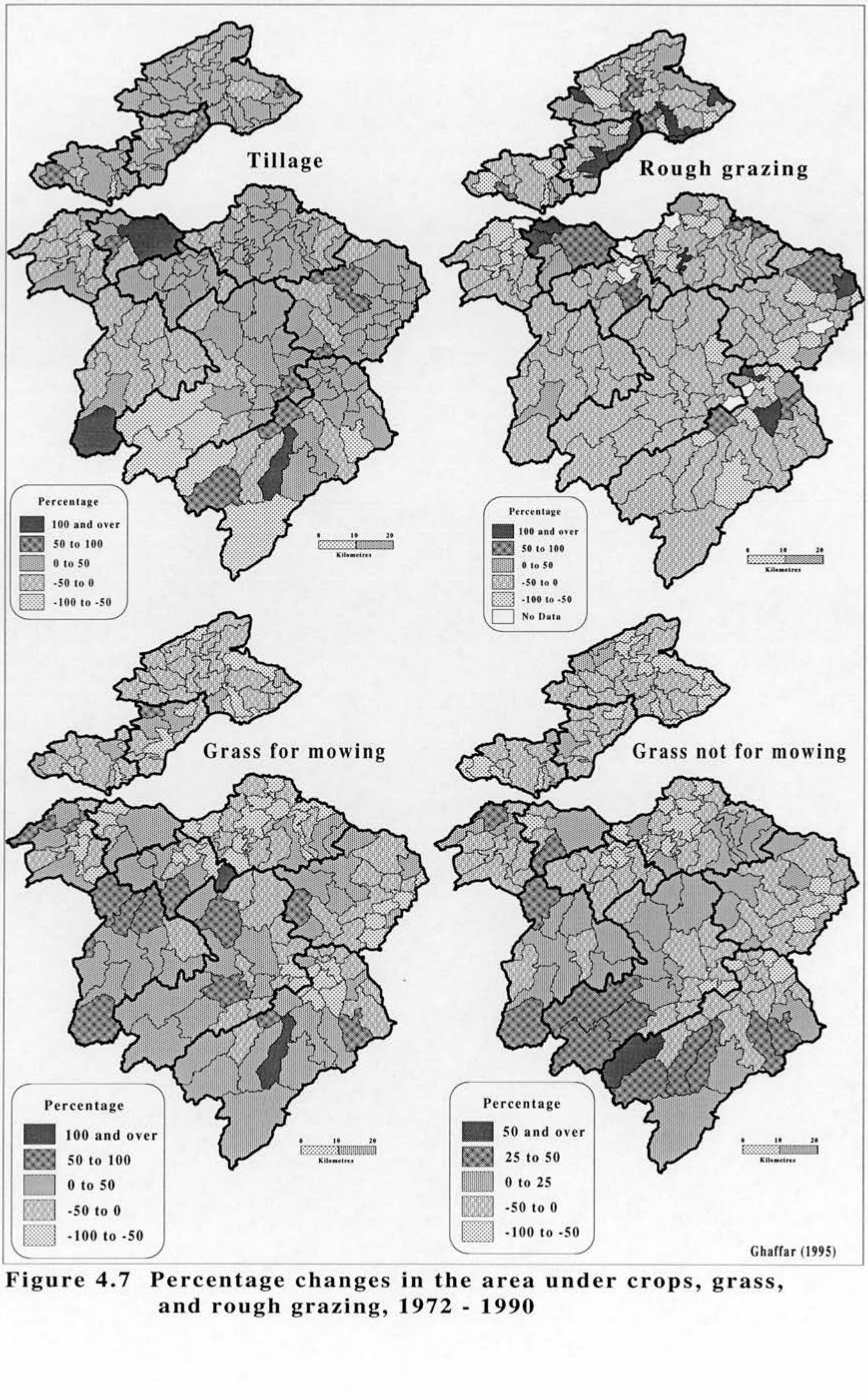


Figure 4.7 Percentage changes in the area under crops, grass, and rough grazing, 1972 - 1990

Roxburghshire and Ettrick & Lauderdale. A few parishes have gained even more than 100% because of an increase in the area under tillage in the parish which had not had any area under tillage in 1972 or had only a very small area under tillage. In Lothian and Borders with areas of class 4 and 5 land (see Figure 4.1) a decline of 50% has occurred, the result probably of abandoning tillage practice in favour of grassland for farm livestock. A higher increase in the area under tillage is mainly due to decrease in the area under grass and rough grazing. This has occurred mainly in those parishes which are crop producing or where land can be improved to produce a narrow range of crops using more agrochemicals and increasing field drainage.

Figure 4.8 presents changes in the areas under tillage in parishes. The dot density maps give a clear picture of an increase in the area under tillage. The area under tillage has increased in North-East Fife, East Lothian , Berwickshire, and in some parishes of West Lothian, Roxburghshire and Ettrick districts which are class 3 agriculture land. Great changes can be observed in the area under tillage as a proportion of agricultural land between 1972-1990. Some parishes in North-East Fife, East Lothian, Berwickshire and Roxburghshire have increased the proportion of tillage in agricultural land more than 80%. The trend of a rising increase can be seen especially in North-East Fife. The fact of tillage increase reflects intensification of crop production and a decrease in the area under grass and rough grazing. The parishes which put land under tillage for the first time show a very high percentage change between 1972 and 1990. Bowler (1983, 1985, 1992) and Robinson (1988, 1993) have noted that there have been great changes in the area under tillage. Under the CAP, higher prices for wheat and oilseed rape have encouraged the farmers to convert their area of grass and rough grazing.

The total area of rough grazing has fallen by 17.52% between 1972 and 1990 (see Table 4.1). A greater decrease (50%) in the area under rough grazing can be observed, widely dispersed, in the Lothian and Borders regions. Fife shows no clear patterns, having a mixture of gains and losses in the area under rough grazing. The decrease in the area under rough grazing is mainly in those parts of South East Scotland which are arable or where land can be improved for arable purposes. Areas

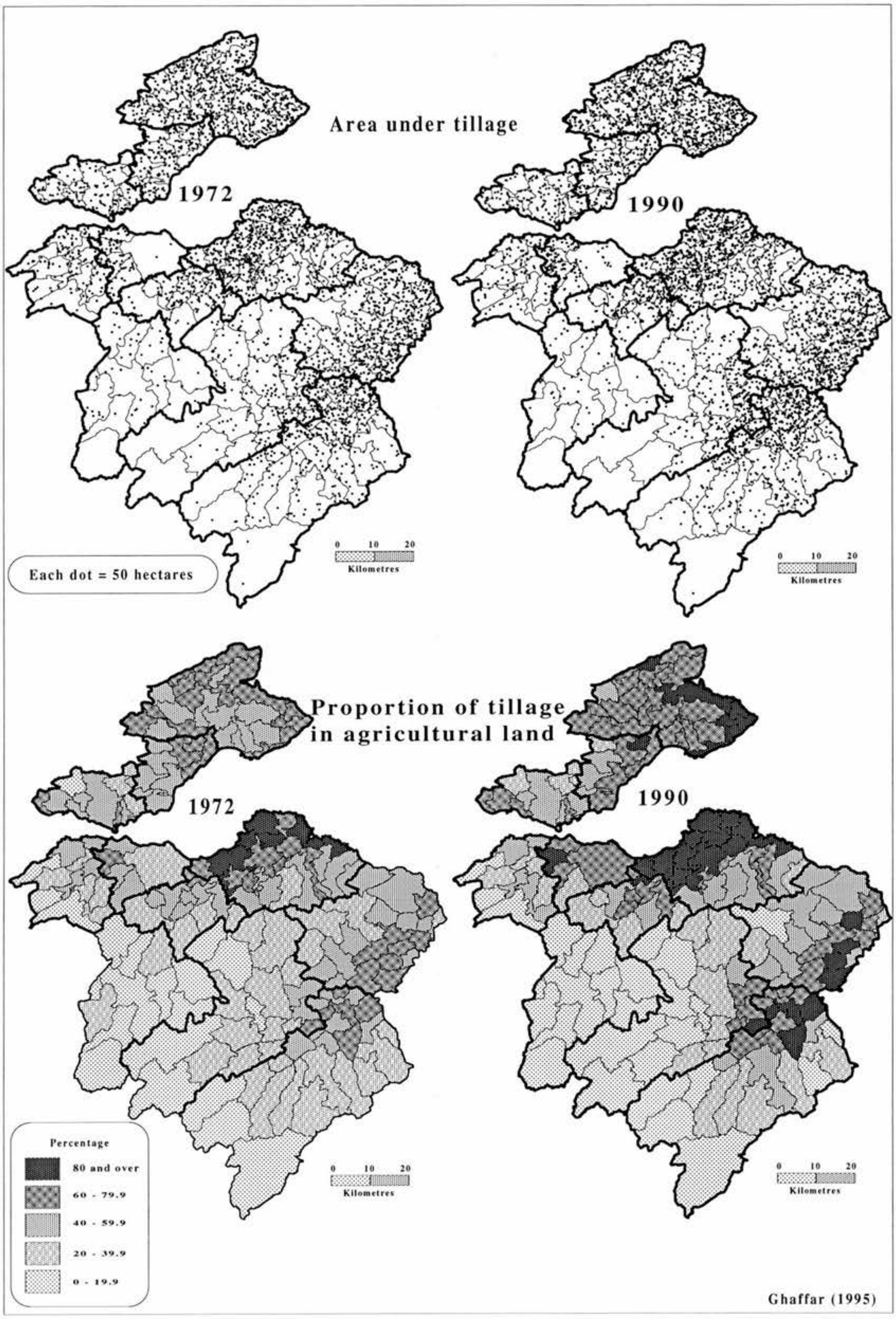


Figure 4.8 Changes in the area under tillage, 1972 - 1990

under grass for mowing have greatly changed. Grass for mowing has declined (more than 50% in some parishes) in Fife, East Lothian and Berwickshire on class 2 and 3 agricultural land. Some parishes in west Lothian, Tweeddale, Ettrick and Roxburghshire have changes up to +100%. All these parishes come under class 5 land (land suited to only improved grass land and rough grazing). These parishes are sheep and beef-cattle producing areas. The area under grass not for mowing has decreased up to 100% in some parishes which have the best agricultural land (especially in North-East Fife, and in East Lothian). In Ettrick and Roxburghshire the area has increased up to 50% in parishes with class 4 and 5 land for agriculture. A comparison between tillage and grass changes reveals that tillage has increased at the expense of grassland.

Table 4.1 reveals great change (+39.92%) in the area under farm woodland. Figure 4.9 shows changes in area under farm woodland. The area under farm woodland has increased in East Lothian, North East Fife, Berwickshire, and Ettrick & Lauderdale. Woodland as a proportion of the total area of land has also increased. Most of the parishes which had up to 4% of their area under woodland in 1972 had up to 6% and in some parishes up to 8% or even 10% in 1990. This increase in the area has occurred where land may not be suited for tillage on the basis of local physiography. It can also be linked with the Farm Woodland Scheme and the Woodland Grant Scheme offered by the government. The parishes with the highest proportion have class 3 land, not the best for arable crops, so it may be that the farmers have been converting some of this land to woodland.

The area under bare fallow has been affected due to the changes in the area under crops and grass. Higher prices for cereals have led to the changes in the area under bare fallow. The area has been decreased in the parishes to increase the cereals productivity. Figure 4.10 show the changes in the area under bare fallow during the period 1972 and 1990. In 1972 there were parishes in East Lothian, West Lothian, Dunfermline and North East Fife which have more than 20 hectares of land under bare fallow. In 1980, the area under bare fallow fell in most of the parishes. It increased only in dairy cattle producing parishes in Ettrick and Lauderdale.

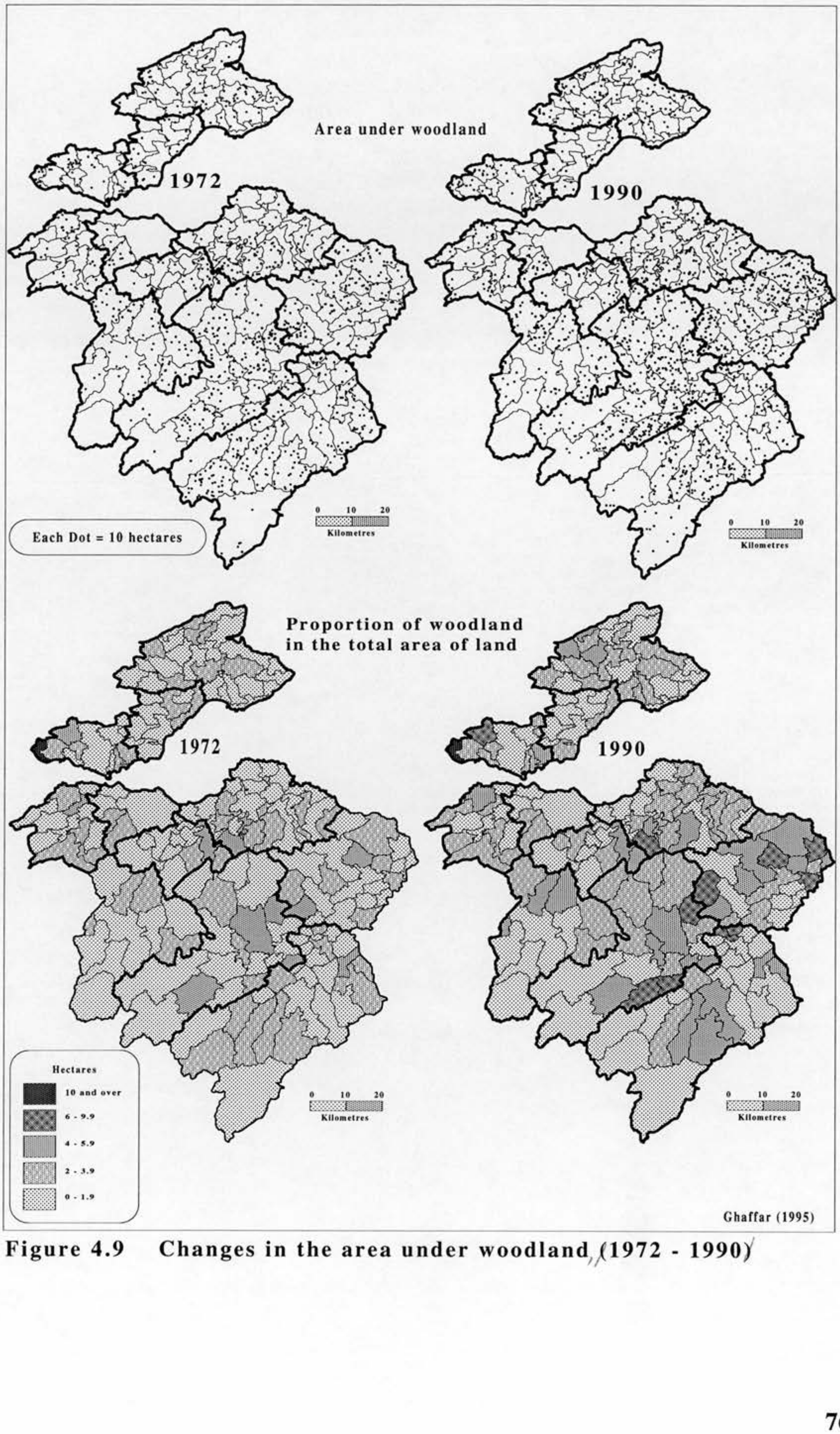


Figure 4.9 Changes in the area under woodland (1972 - 1990)

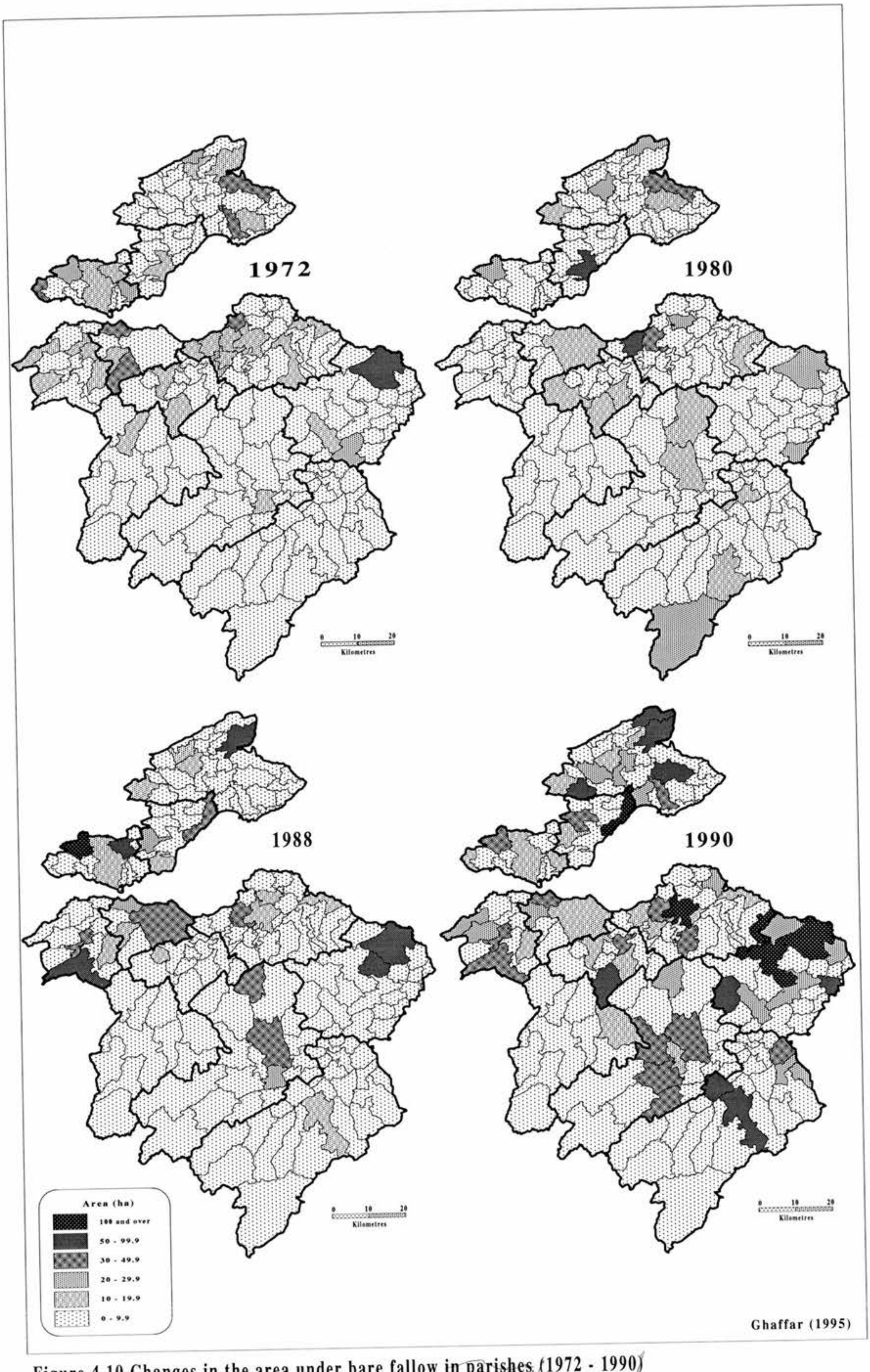


Figure 4.10 Changes in the area under bare fallow in parishes (1972 - 1990)

The area under bare fallow began to increase in the parishes from 1988 (Figure 4.10). The area rose sharply in 1990 in most of the parishes including crop producing parishes of East Lothian, Berwickshire, North East Fife and other arable parts of South East Scotland. This sudden increase has resulted due the introduction of the Set Aside Scheme and the change in the price support policy. The decline in the intervention price of cereals and the offer of funding for not cultivating some arable land has affected the area under bare fallow. Some parishes have increased their area more than 100 hectares under bare fallow in 1990.

Major changes have also occurred in the area under vegetable production. In 1972, vegetables were produced mainly in East Lothian, North East Fife and a few parishes of Roxburgh (Figure 4.11). In 1980, the area under vegetable production had spread in the arable parts of South East Scotland reflecting the support for vegetable production under the Horticulture schemes of the CAP. The production has increased due to the introduction of glass houses for vegetable production. In 1988, the area under vegetable production increased enormously in North East Fife and Berwickshire but decreased in East Lothian. The increase shows the patterns of glass house production in the parishes which are not more suitable for wheat or oilseed rape production. The decrease in the area in East Lothian can be linked to the adoption of oilseed rape in the area. The area under vegetable production has decreased in some parishes of South East Scotland between 1988 and 1990. On the whole the area under vegetable production has been increased between 1972 and 1988. Although it has been decreased in the parishes of higher wheat and oilseed production. The decrease appeared after 1988 which clearly shows the change in price support policy and the reforms in the structural policies.

4.2.3 Changes in Major crops

Figure 4.12 describes the changing patterns of the area under cereal production (wheat, barley, oats). The area under cereals production has increased especially in North East Fife, East Lothian, Berwickshire, and Roxburghshire. The total change between 1972 and 1990 was an increase of 11.32% (Table 4.2). The area under

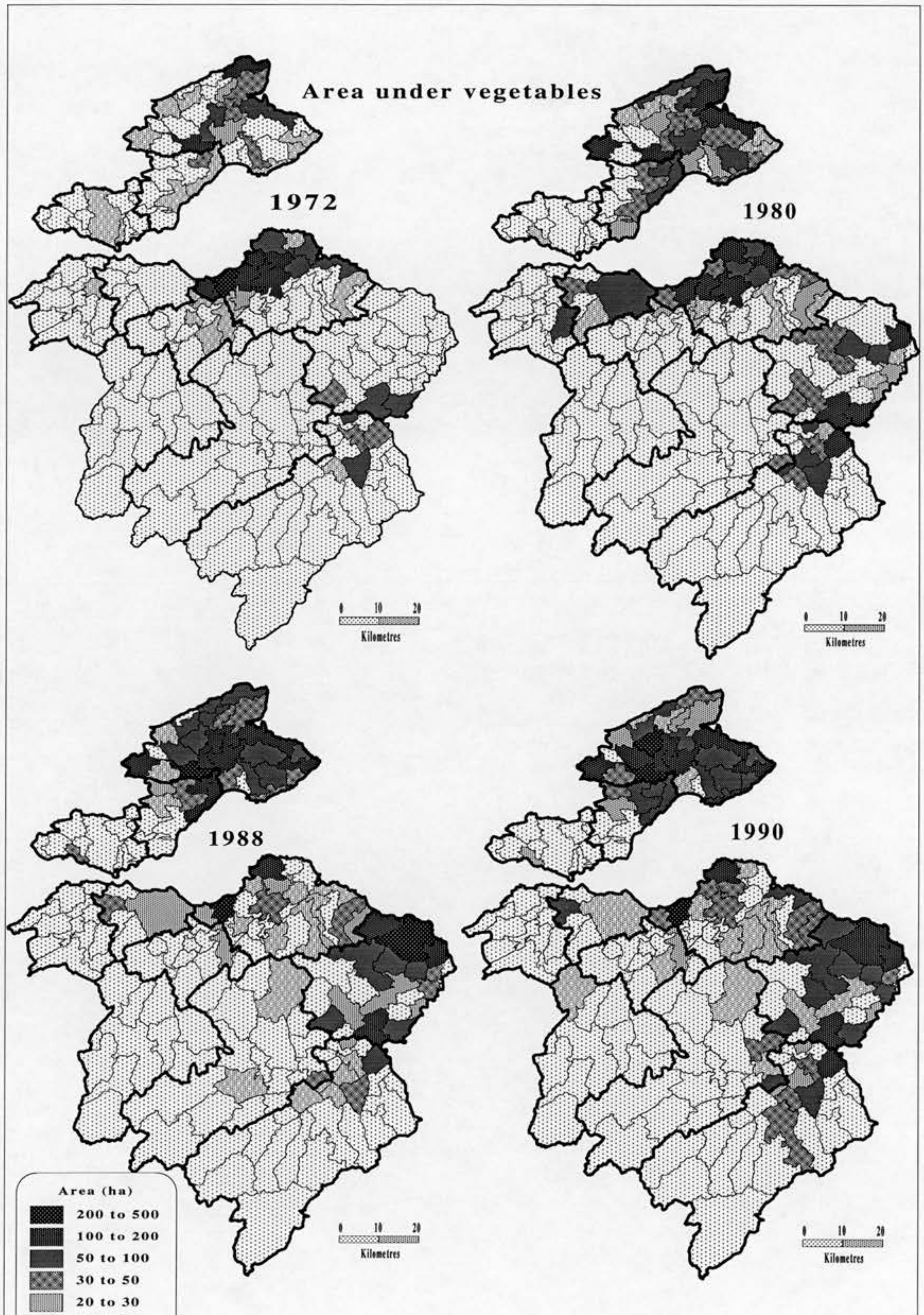


Figure 4.11 Changes in the area under vegetables, 1972 - 1990

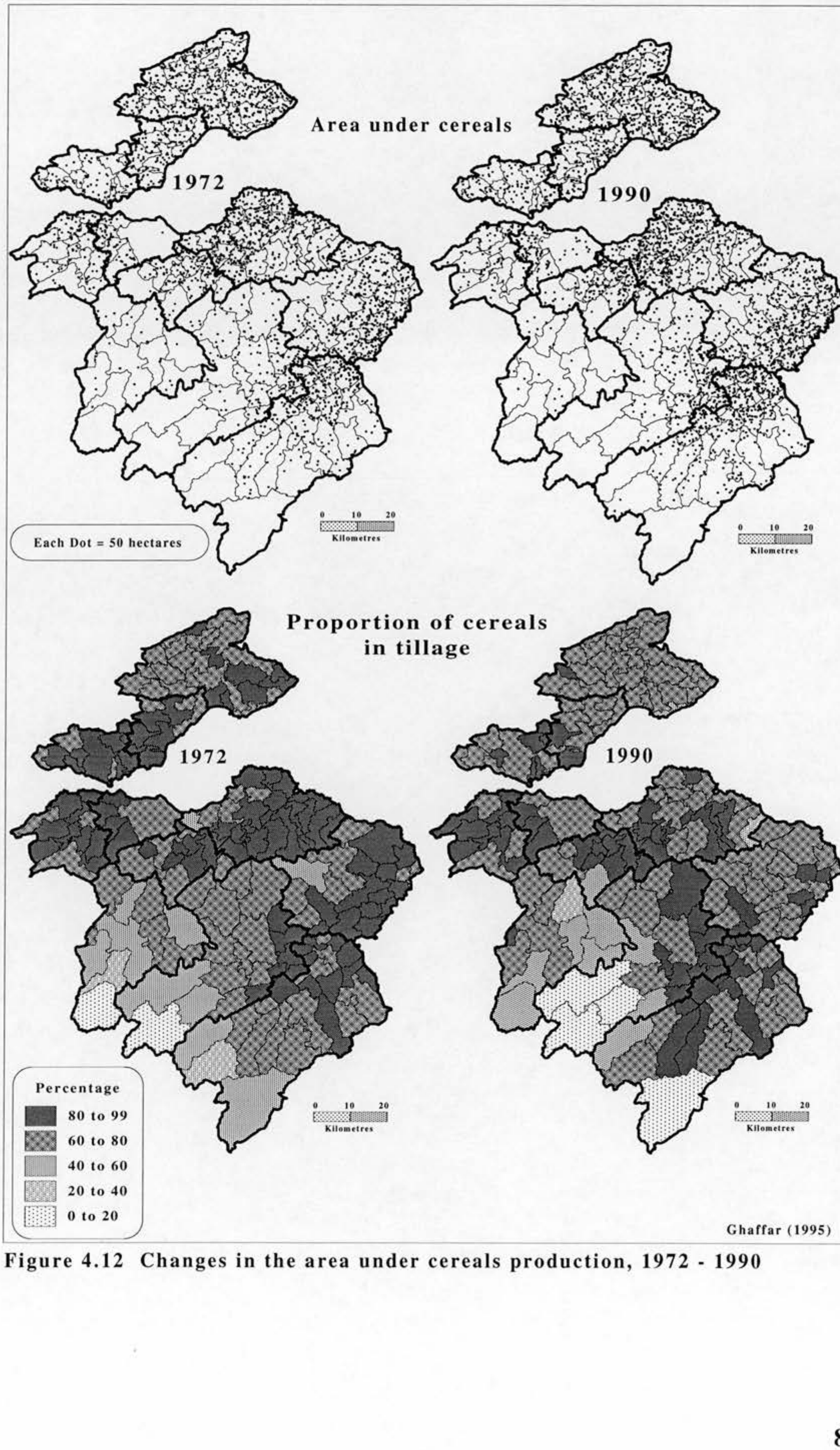


Figure 4.12 Changes in the area under cereals production, 1972 - 1990

barley and oats has decreased but the area under wheat has increased greatly between 1972 to 1990. An increase in the area under cereals has been a major feature of agricultural change in the community under the CAP (Bowler, 1985: 112). However, the proportion of cereals in tillage has decreased between 1972 and 1990. Most of the parishes which had more than 80% share in tillage have reduced to less than 80% share of cereals in tillage. One possible reason is that the area under tillage has itself risen during the period 1972-1990 (Table 4.2), and the area under other crops such as oilseed rape, vegetables and others has increased during this period. Some parishes which, previously, had less than 80% cereals share in tillage have risen to more than 80% (especially in Ettrick and Roxburgh). These parishes are mainly 4 and 5 land, capable of supporting only a narrow range of crops and improved grassland. More land has been improved for cereal production. Figure 4.13 describes the percentage changes in area under major crops between 1972-1990. The crop-producing parishes in North-East Fife, East Lothian and Berwickshire have increased by more than +200%. The non-crop-producing parishes have a very high percentage change, above +1000%. This very high percentage change in West Lothian, Ettrick and Roxburghshire is to be explained by the increasing trend of bringing new areas under wheat production, and even a very small change in area under wheat production may result in a very high percentage change. Almost all parishes in Tweeddale have a -99% change showing either no change or very high change. Barley has decreased in area in nearly all parishes of North-East Fife, East Lothian, Berwickshire and those parts of Roxburghshire best suited for arable crops. It has up to +100% change in Ettrick.

The area under oats has a very high decrease, up to -100%, in all parishes of South East Scotland, the result of being replaced by wheat production which has been

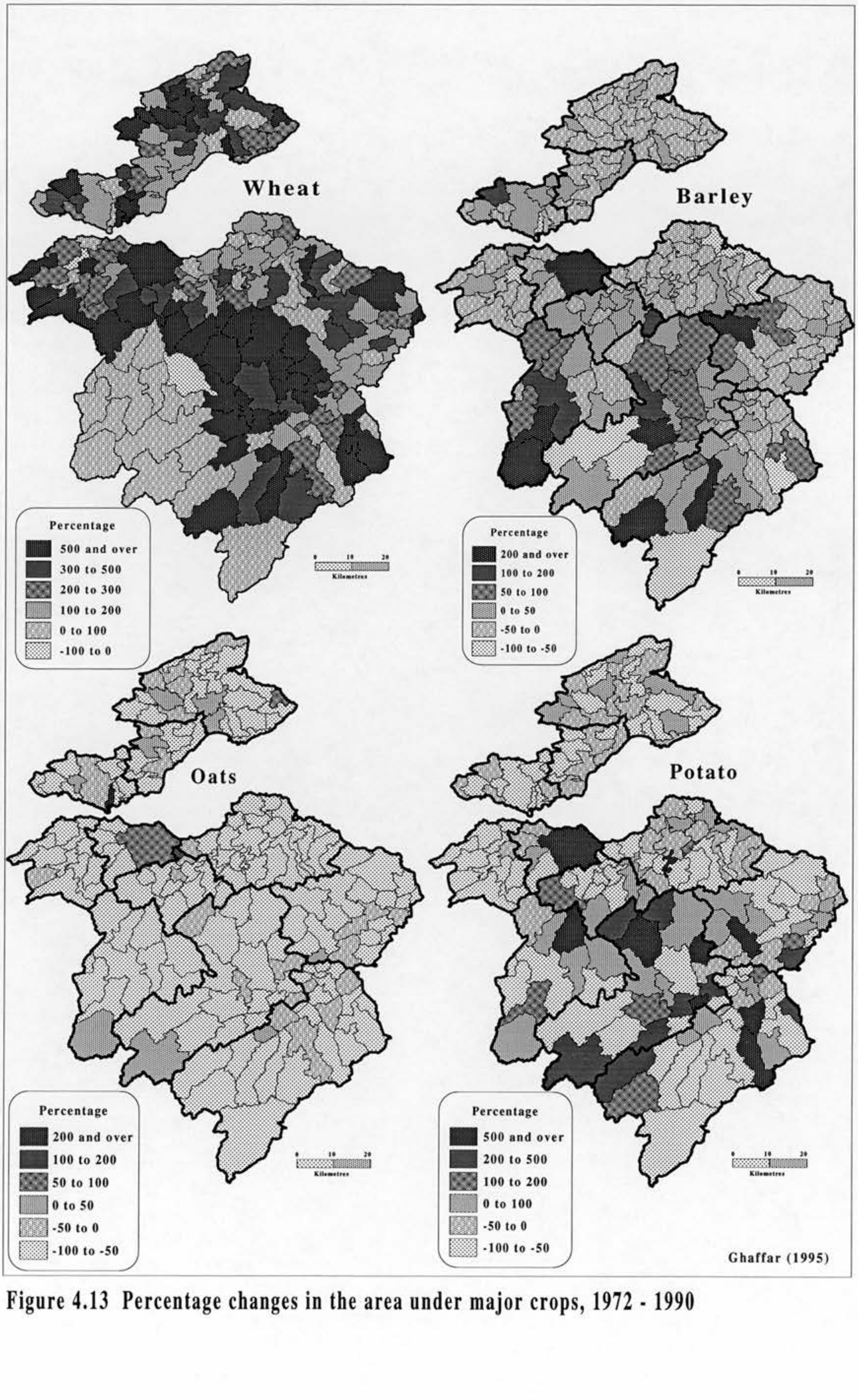


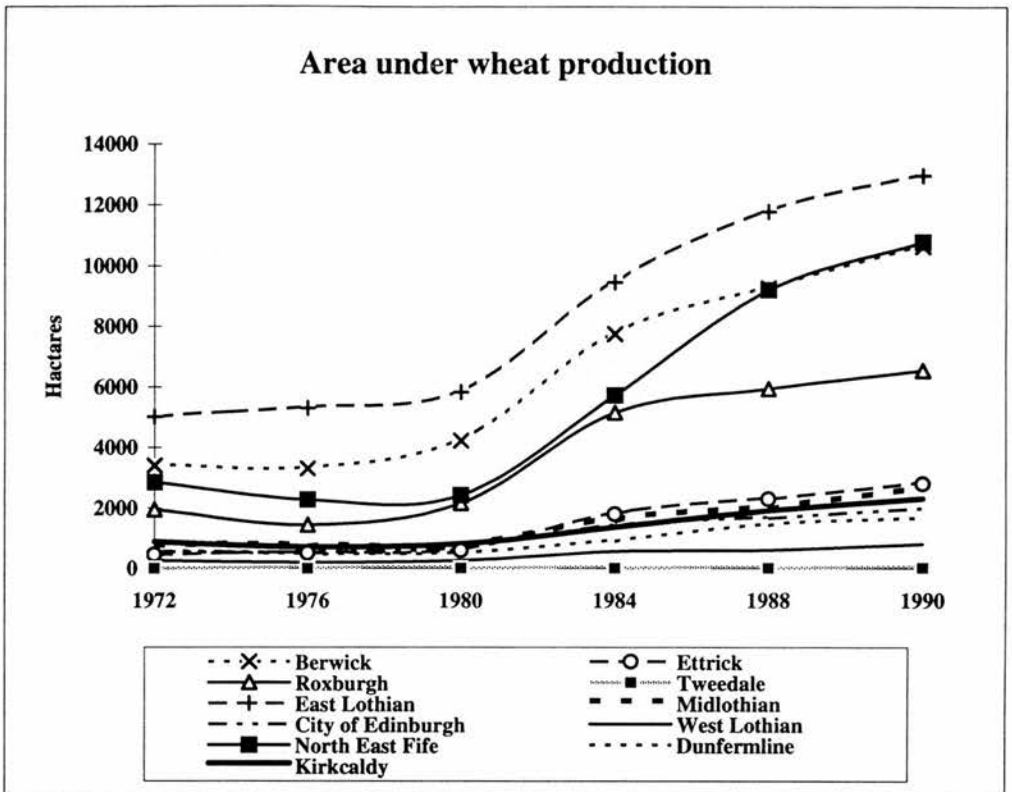
Figure 4.13 Percentage changes in the area under major crops, 1972 - 1990

receiving higher prices than oats. Although the area under potato production has decreased in most parishes, it has increased in some by more than 1000%.

Figure 4.14 show changes in the area under wheat production at district level. Berwick, Roxburghshire, East Lothian and North-East Fife are the main wheat-producing areas. A very high rate of change has occurred in all these four districts. The area under wheat production has increased from 5000 ha to more than 13000 ha in East Lothian; from less than 4000 ha to about 10000 ha in Berwickshire; and from 3000 ha to 10000 ha in North-East Fife. All other districts show only a slight increase in the area under wheat production. Figure 4.15 describes the change in area under wheat production in parishes. The concentration of wheat production has occurred in North-East Fife, East Lothian, Berwickshire, a major part of Roxburghshire and some parishes of Midlothian and West Lothian. The proportion of wheat under agricultural land has also increased tremendously in some parishes between 1972 and 1990. The proportion under wheat has risen from 10 - 20% to up to 40% and in some parishes up to 50%, half of the total area of agricultural land.

The area under barley production has risen and fallen between 1972-1990 (see Figure 4.14). The area under barley had a steady increase prior to 1980 in almost all districts. But after 1980 it started to fall, and by 1990, it had fallen below even the actual area of 1972 in North East Fife, East Lothian, Berwickshire and Roxburghshire. All other districts had a very small but steady increase before 1990. Changes in the area under barley production can be seen in Figure 4.16. The proportion of agricultural land under barley has also declined. Most of the parishes which had 40% and even 50% under barley have fallen to a proportion of up to 30%. Barley has received a lower price under CAP support policy, but as a feed for cattle it has remained an important crop in the area.

The total area under oats has fallen from 17673 ha to 4879 ha between 1972 and 1990, a decline of 72.4%. Oats represented about 5% of agricultural land in 1972 but only 1.36% in 1990 (Table 4.2). The area under oats has decreased in all districts (Figure 4.17). A very high and sharp decrease has occurred in Berwickshire, Ettrick, Roxburghshire, West Lothian and East Lothian from 1972 to 1984. A steady increase



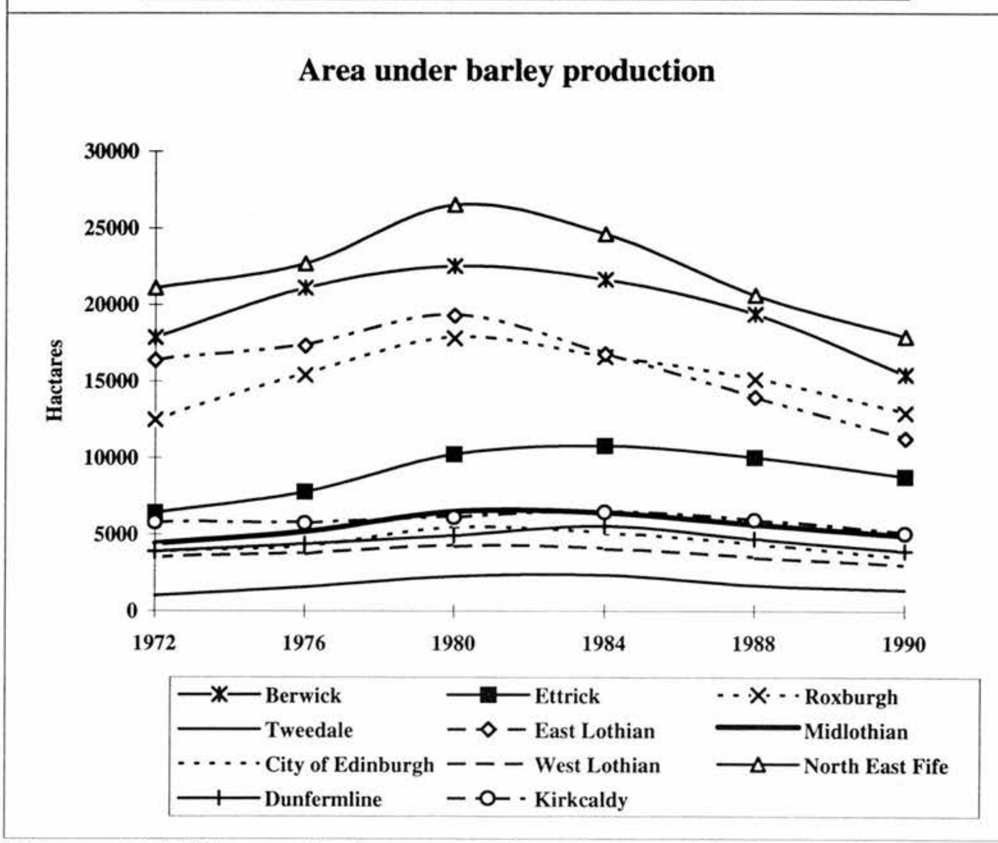


Figure 4.14 Changes in the area under wheat and barley in districts

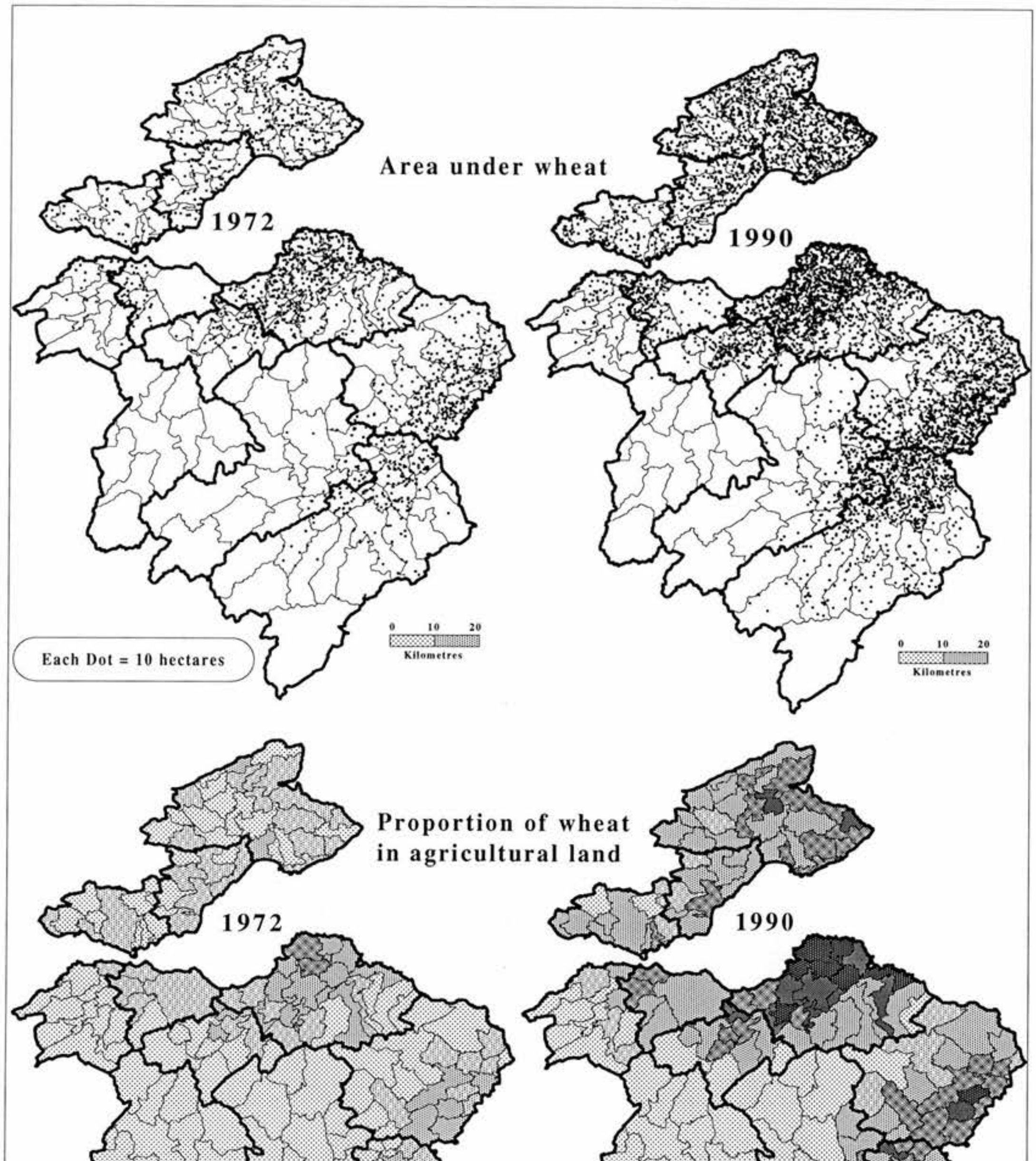


Figure 4.15 Changes in the area under wheat production, 1972 - 1990

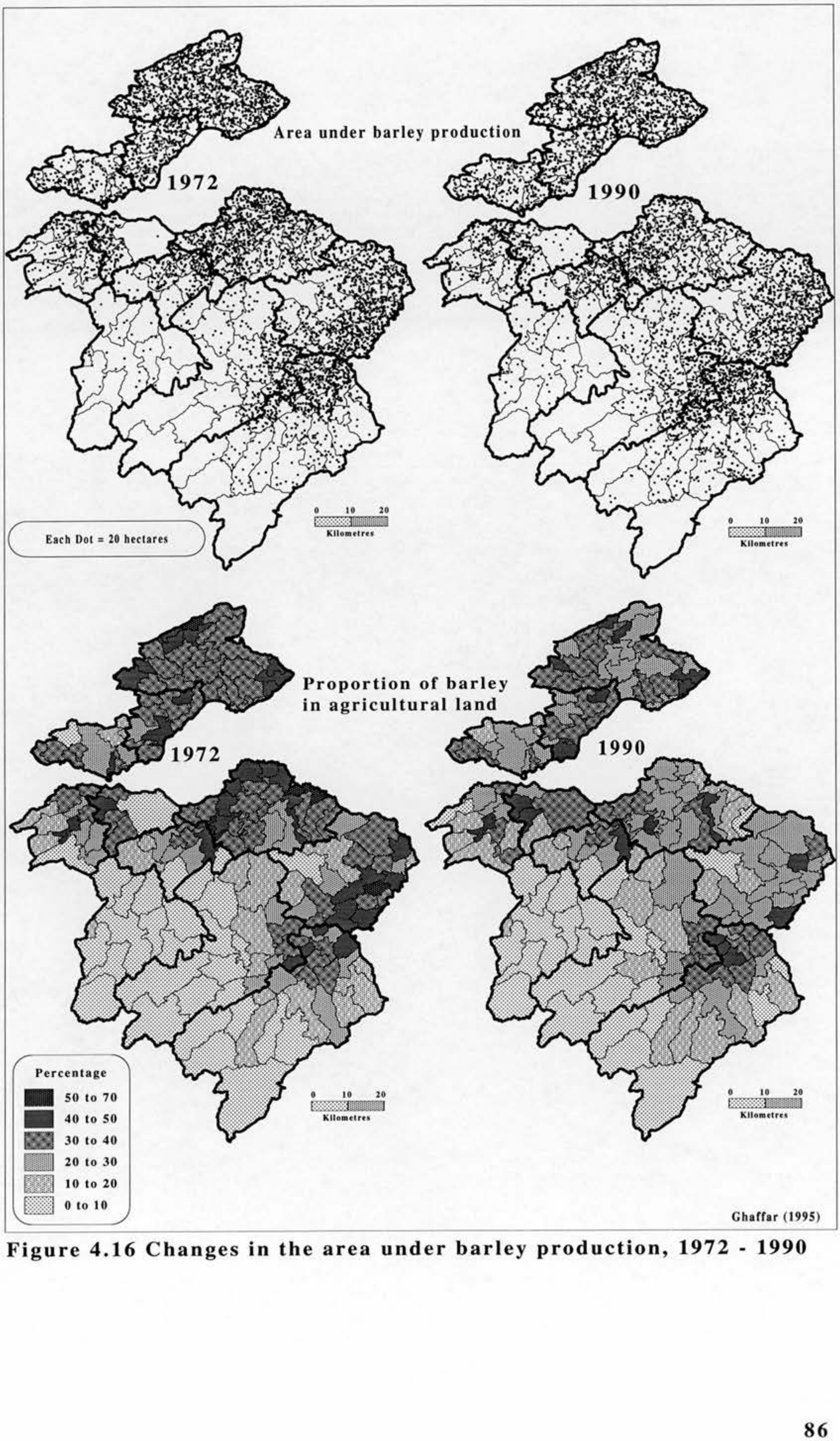
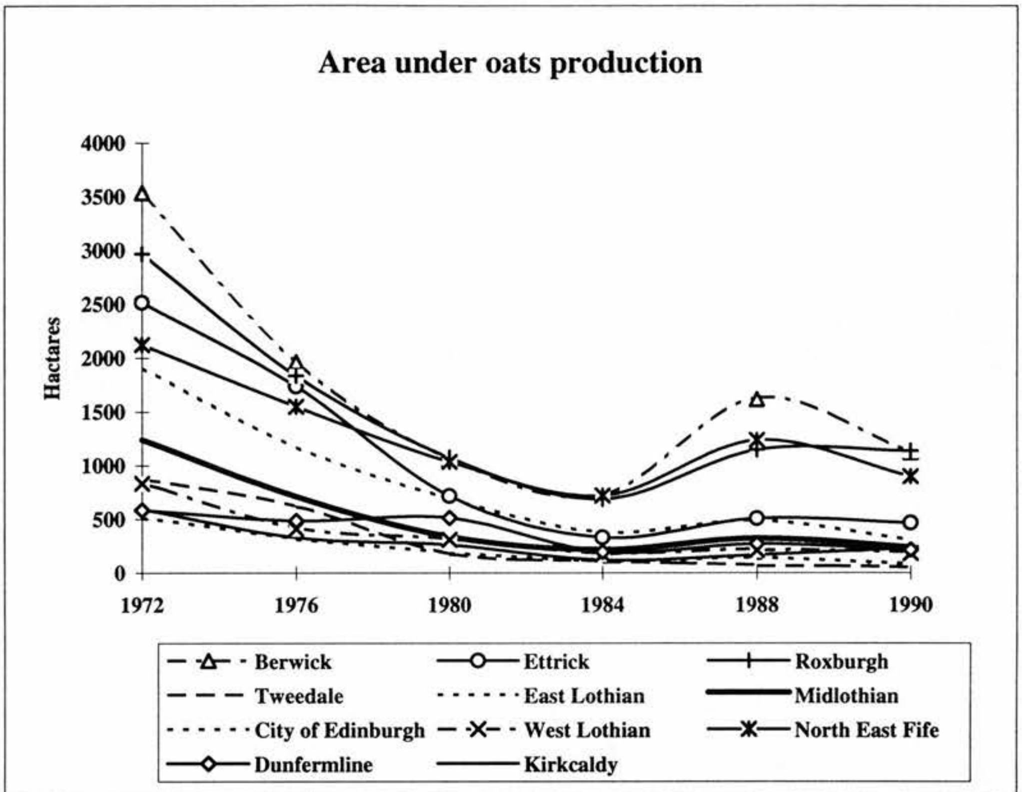


Figure 4.16 Changes in the area under barley production, 1972 - 1990



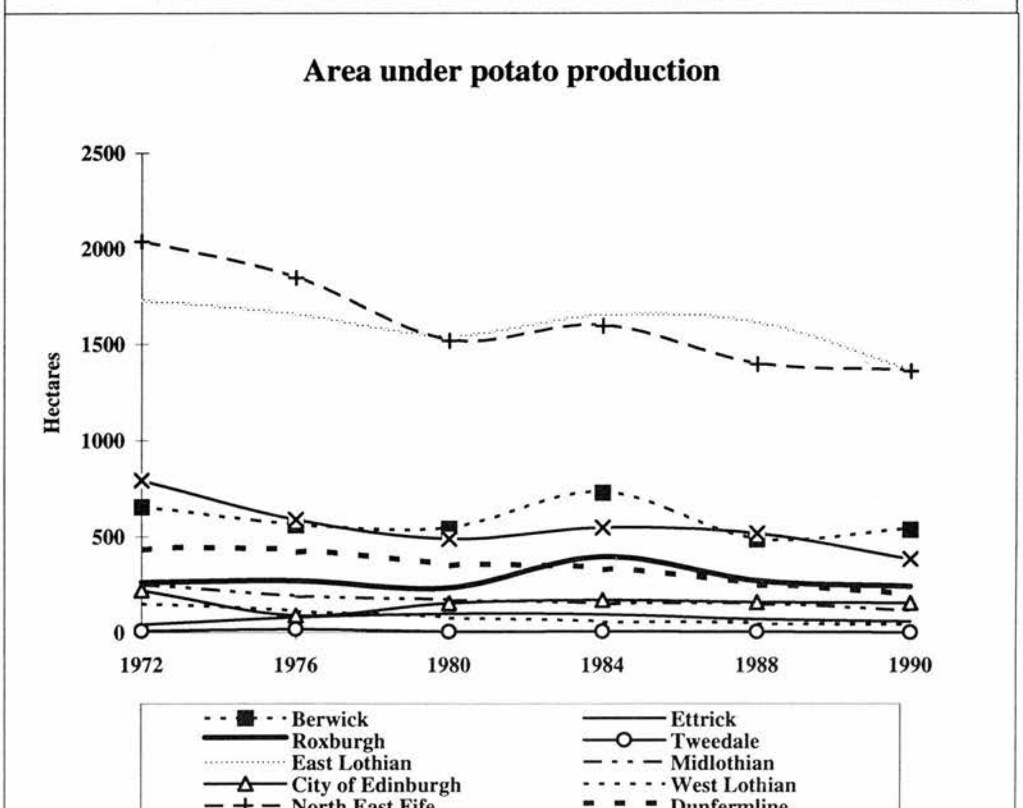


Figure 4.17 Changes in the area under oats and potatoes in districts

has occurred from 1984-88, but from 1988 to 1990 it has declined. The pattern of changes can be observed in Figure 4.18. Oats have almost disappeared in most parishes: a very small concentration remains in North-East Fife, Berwickshire and Roxburghshire. In 1972 oats made up 15% of agricultural land or even 25% and, in a few parishes, up to 50% of agricultural land.

The total area under potato production was decreased from 6577 ha to 4439 ha (-32.5%) between 1972 and 1990 (see Table 4.2) mainly because of quotas on potato production. The pattern of changes in districts can be seen in Figure 4.17. North-East Fife and East Lothian were major potato producing districts in 1972. There have been fluctuations in the area under potatoes in all districts. The pattern of changes in the parishes can be observed in Figure 4.19. The proportion of agricultural land under potatoes has also decreased in most of the parishes. In some parishes it has decreased from 10% to less than 4% of agricultural land. It has remained constant or had only very small changes in some parishes of East Lothian.

The area under oil seed rape production has increased greatly. Oil seed rape was first sown in the early 1980s. From 1984 to 1990 it increased from virtually nothing to 15538 ha in South East Scotland. The pattern of changes in area under oil seed rape from 1984 to 1990 can be seen in Figure 4.20. In only 6 years it became widely spread in the whole Fife region, East Lothian, Midlothian, City of Edinburgh, Berwickshire and Roxburgh. In 1984 it was not more than 7.5% of agricultural land in some parishes. In 1990 it increased to 20% of agricultural land in most of Fife, Lothian and Roxburghshire.The area under wheat and oilseed rape production has increased at the expense of oats, barley and potatoes. This is mainly because of high prices for wheat and oilseed rape as compared to barley, oats and potatoes. Bowler (1985) has noted that the price for wheat rose three-fold between 1970 to 1980 while the prices for barley (about two-fold) and for oats (less than 100%) remained less than wheat. Oilseed rape has risen enormously since 1984. The main reason for this increase is its price support which has encouraged the farmers to put more land under oilseed rape.

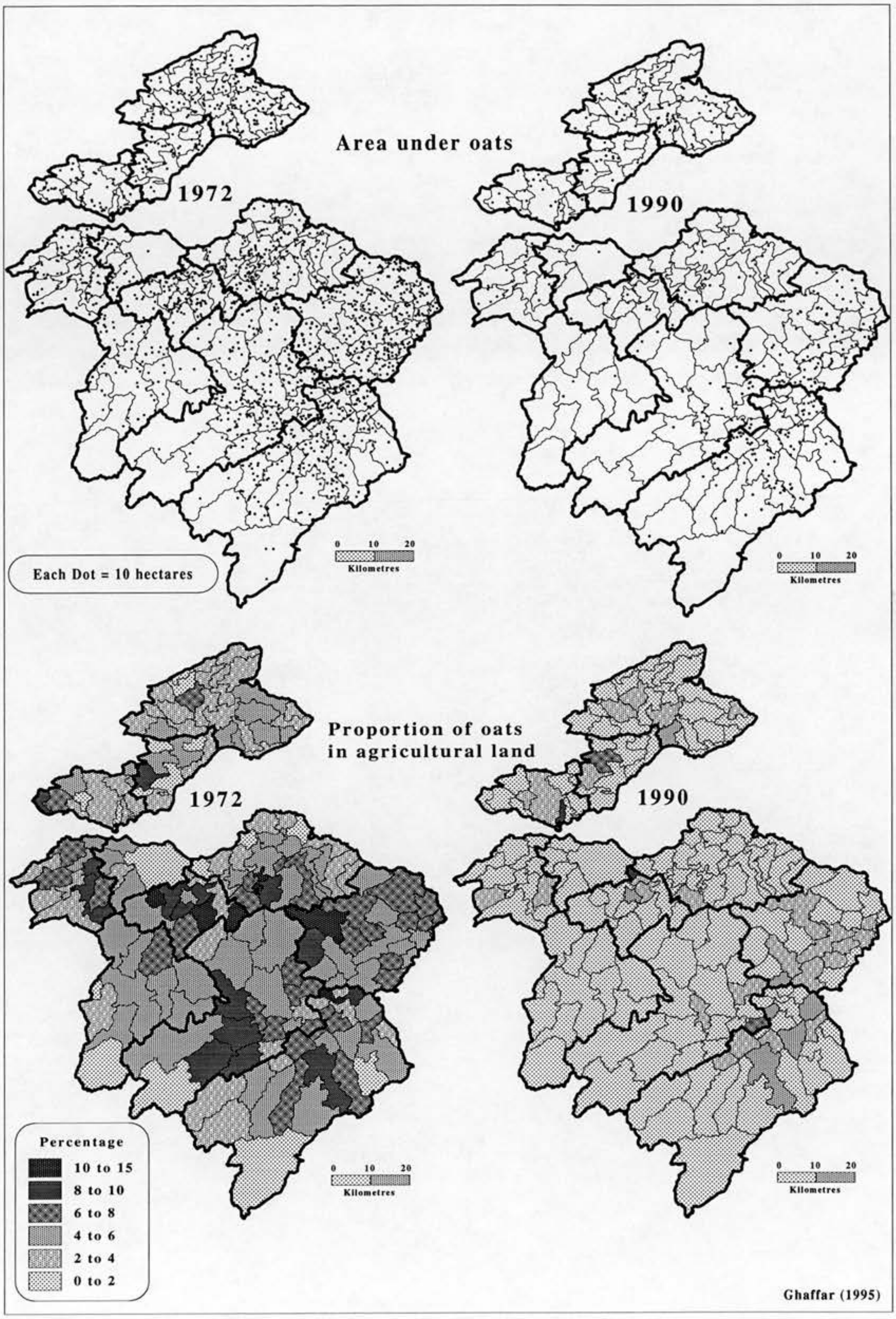


Figure 4.18 Changes in the area under oats production, 1972 - 1990

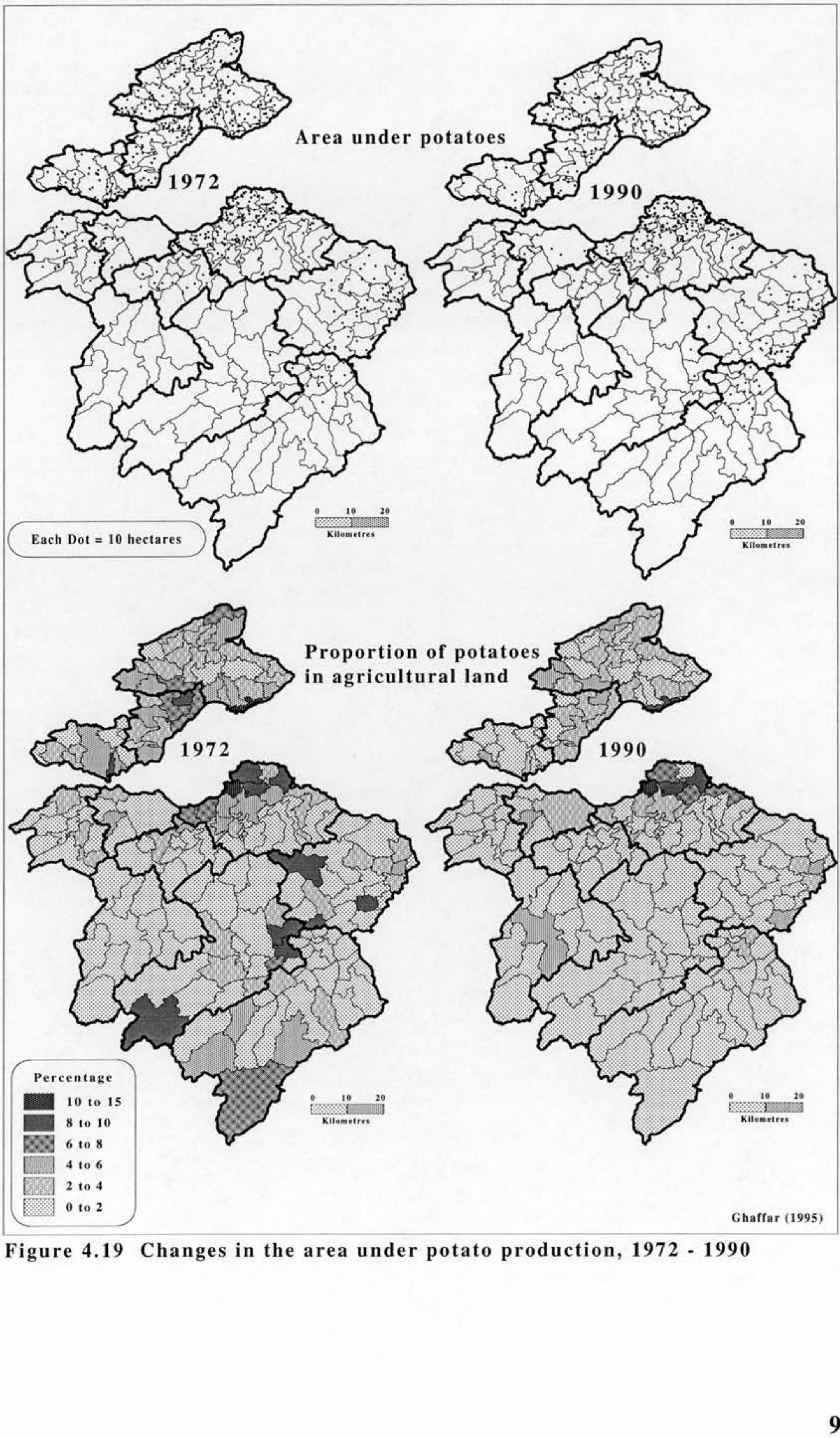


Figure 4.19 Changes in the area under potato production, 1972 - 1990

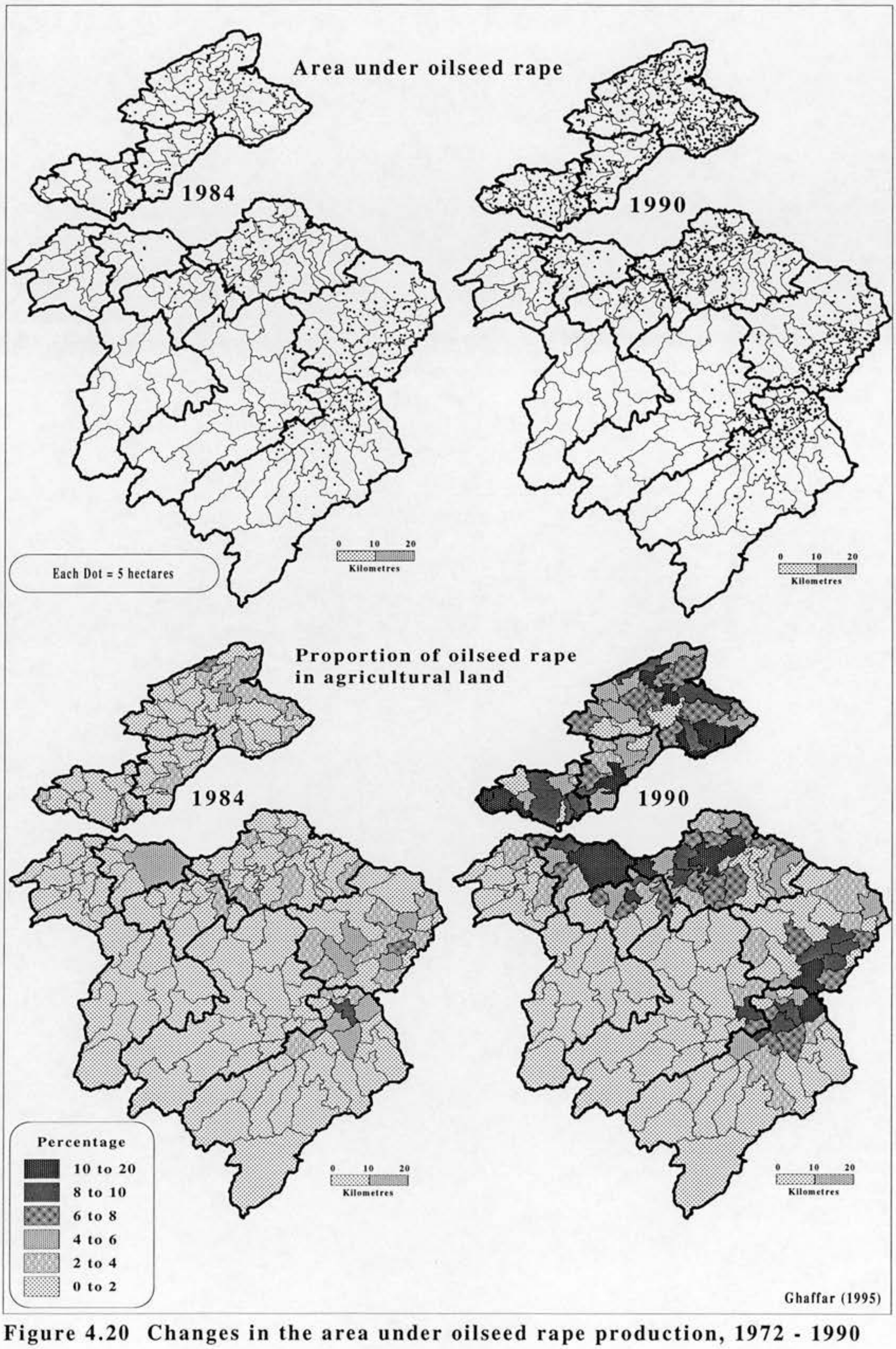


Figure 4.20 Changes in the area under oilseed rape production, 1972 - 1990

4.2.4 Farm Livestock

A decrease in major dairy cattle-producing districts (North East Fife, Kirkcaldy, Dunfermline and West Lothian) can be observed (Figure 4.21 and 4.22). Parishes which were major dairy-cattle producing areas in 1972 have declined greatly in numbers of head, and the density of dairy-cattle has fallen greatly. One of the reasons for this decrease is the quota system for milk production operating since 1984. Figure 4.21 illustates the changes in beef cattle production in districts between 1972 and 1990. A sharp decrease can be seen from 1972 to 1976. Change after 1976 was more gradual and sustained in all districts up to 1990. The major beef-cattle producing districts decreased in production between 1972 and 1990. The highest changes are found in Roxburghshire, Ettrick, Berwickshire, North East Fife and East Lothian (Figure 4.23). A number of parishes ceased production. Changes in the density of beef-cattle also occurred in those parishes best suited for arable crops. The total number of cattle has decreased from 315,637 to 264,110 (-16.32%) between 1972 and 1990 in South East Scotland (see Table 4.3). The density of total cattle (all types) per 100 ha of agricultural land has also decreased from 91 to 74 between these dates. Figure 4.24 shows changes in the distribution of all cattle (all types) at district level. North East Fife, Berwickshire, Ettrick and Roxburgh are major cattle-producing districts in South East Scotland. Two areas of cattle production are distinctive from the Figure. In the first area North-East Fife greatly decreased its cattle production. The second area, which consists of all other districts, has a pattern of very slight change. Figure 4.25 shows that there has been a decrease especially in North East Fife, East Lothian, Berwickshire and Roxburghshire. The density of cattle has also decreased per 100 ha of agricultural land in spite of an increase in the area of agricultural land (see Table 4.1). The parishes in the eastern part of South East Scotland (best suited for arable crops) have a greater decrease in cattle density notably, in Fife region.

Bowler (1985) noted that despite a decrease in the total number of dairy cattle, the average yield of a dairy cow has continued to rise (1.4% a year) despite a fall in the number of producers and a gradual decline in the number of dairy cows (0.2 percent a year). Subsidies such as the Hill Livestock Compensatory Allowances

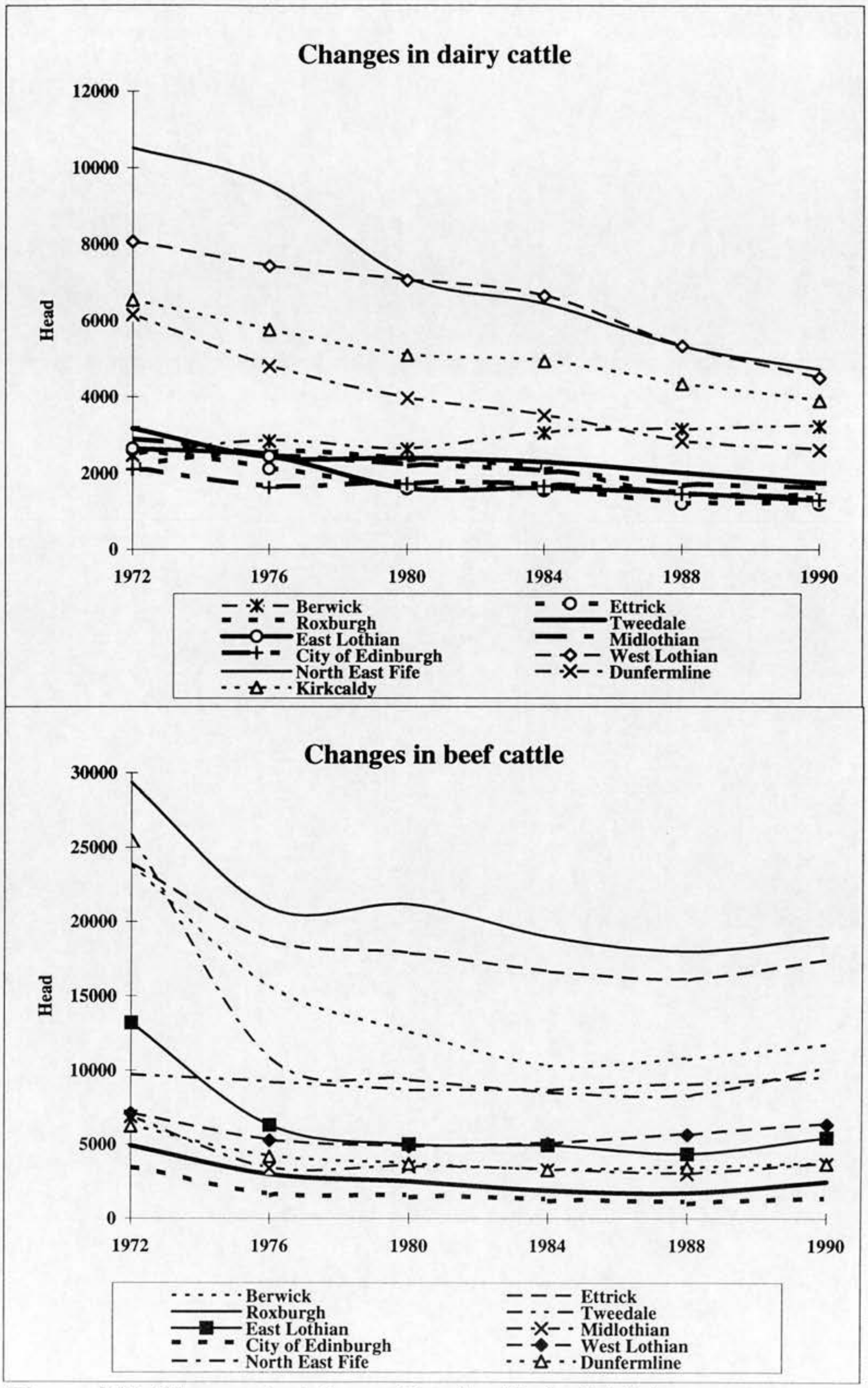


Figure 4.21 Changes in dairy and beef cattle in districts

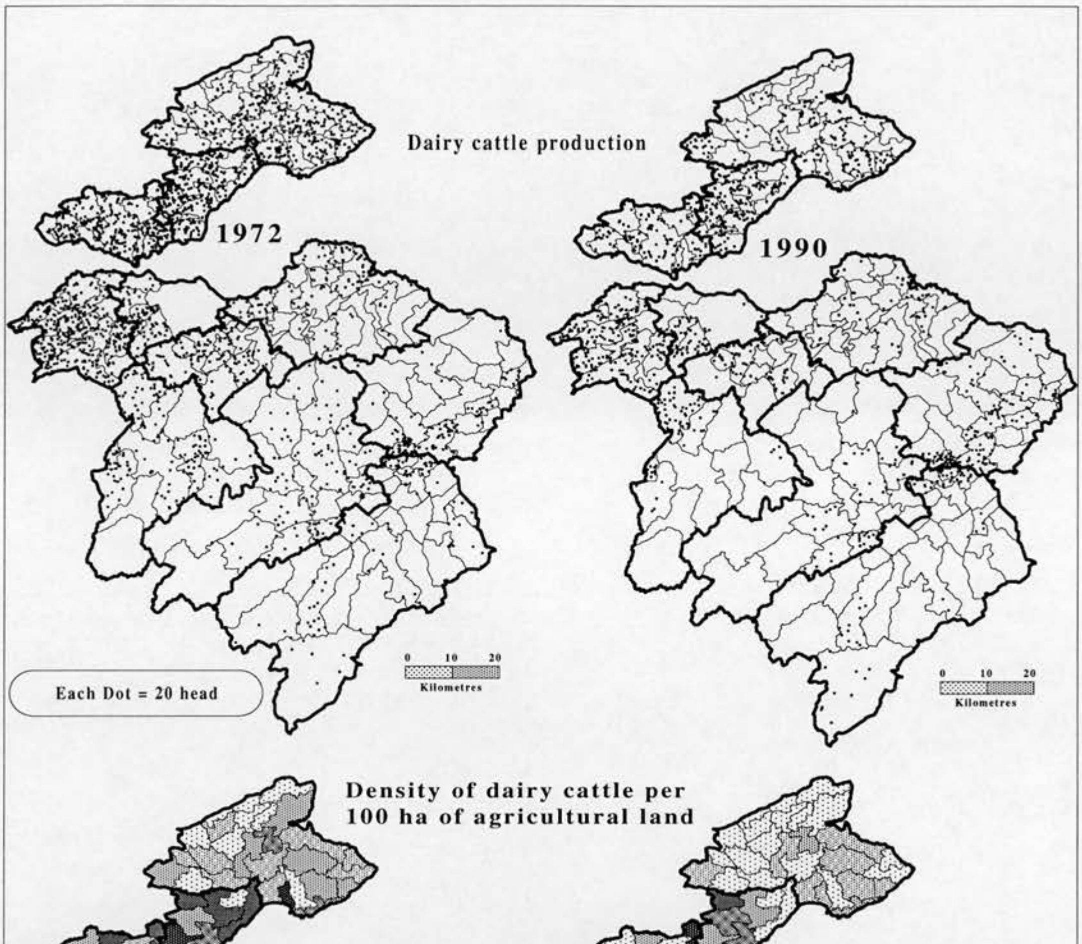


Figure 4.22 Changes in dairy cattle production, 1972 - 1990

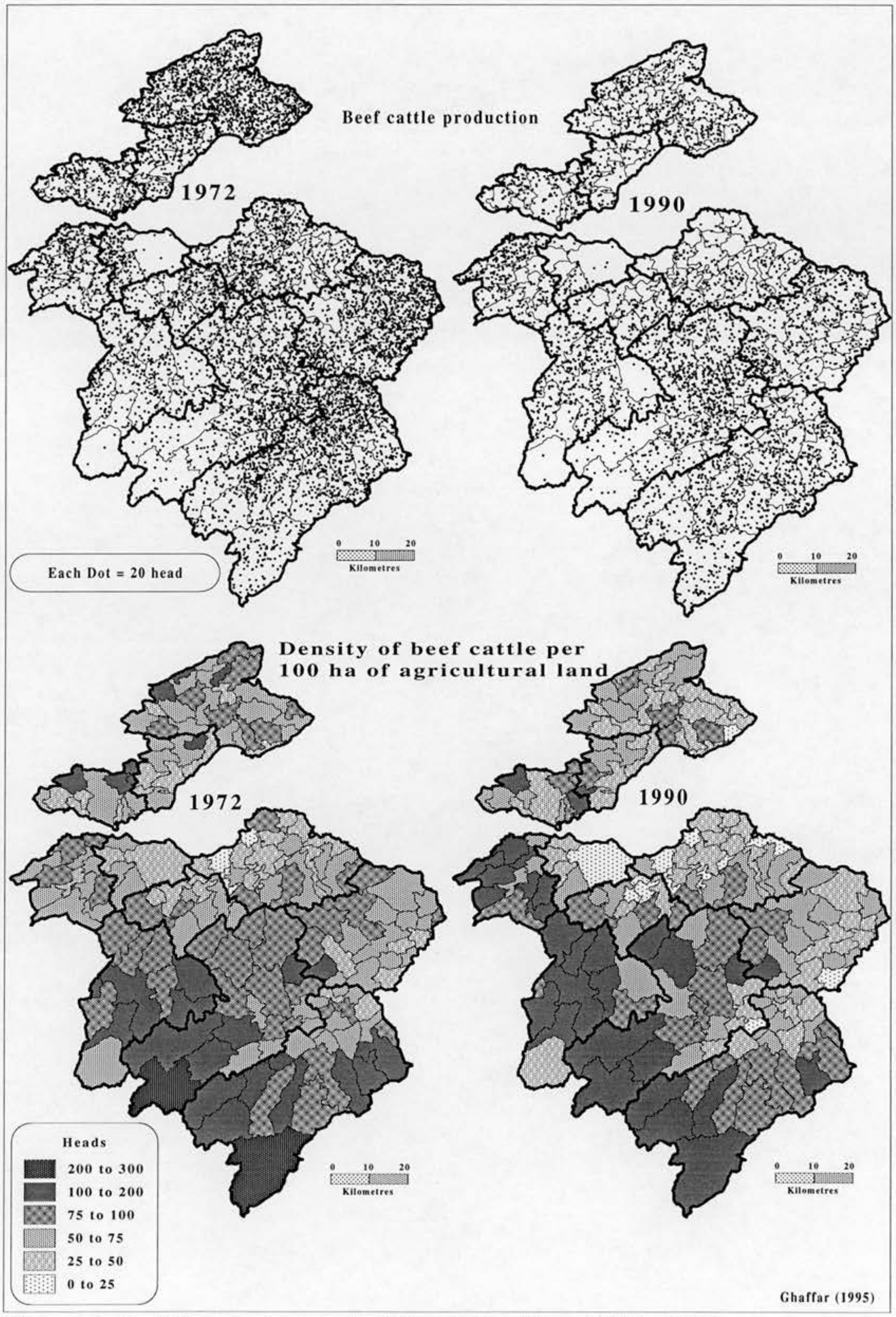


Figure 4.23 Changes in beef cattle production, 1972 - 1990

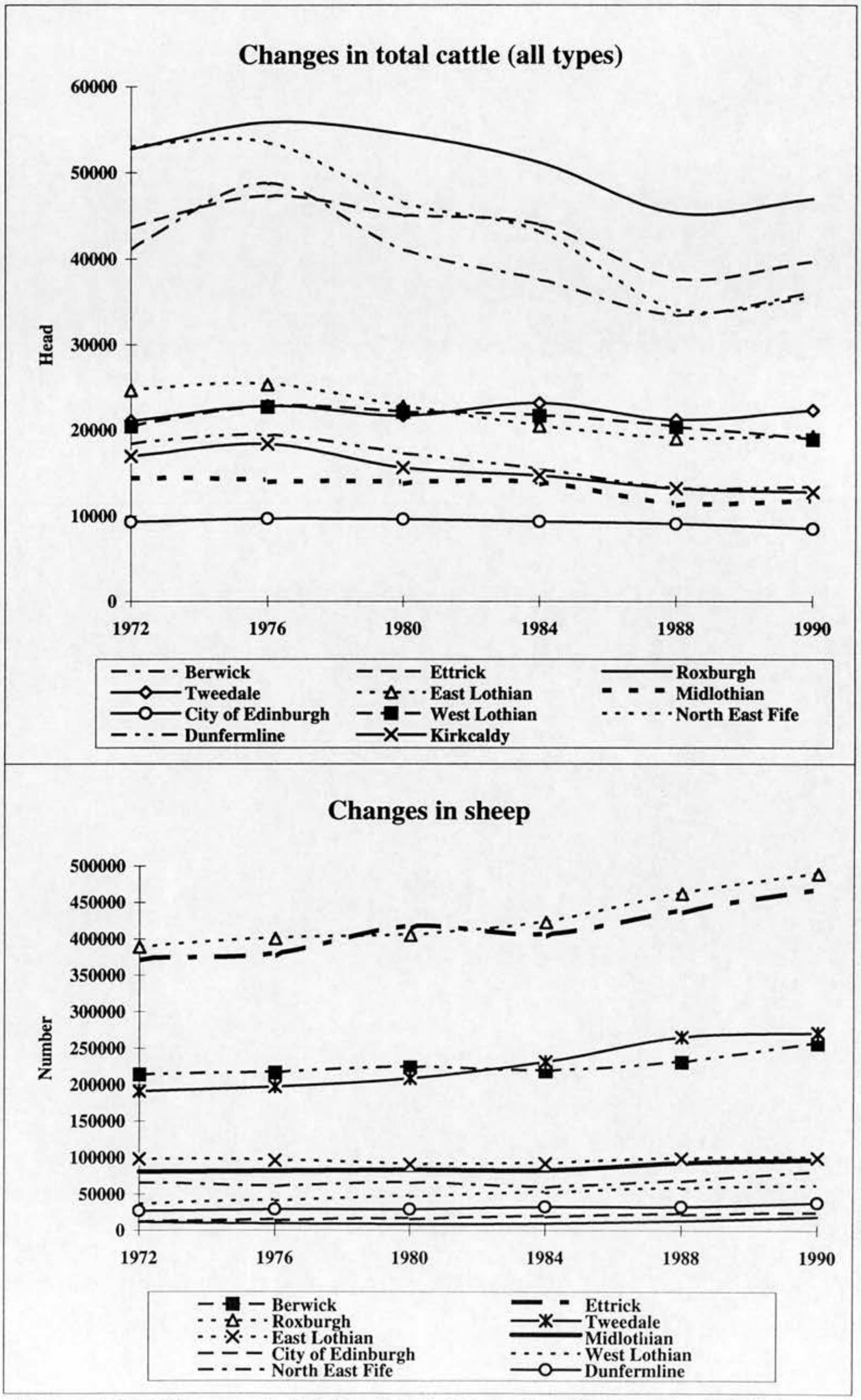


Figure 4.24 Changes in total cattle (all types) and sheep in districts

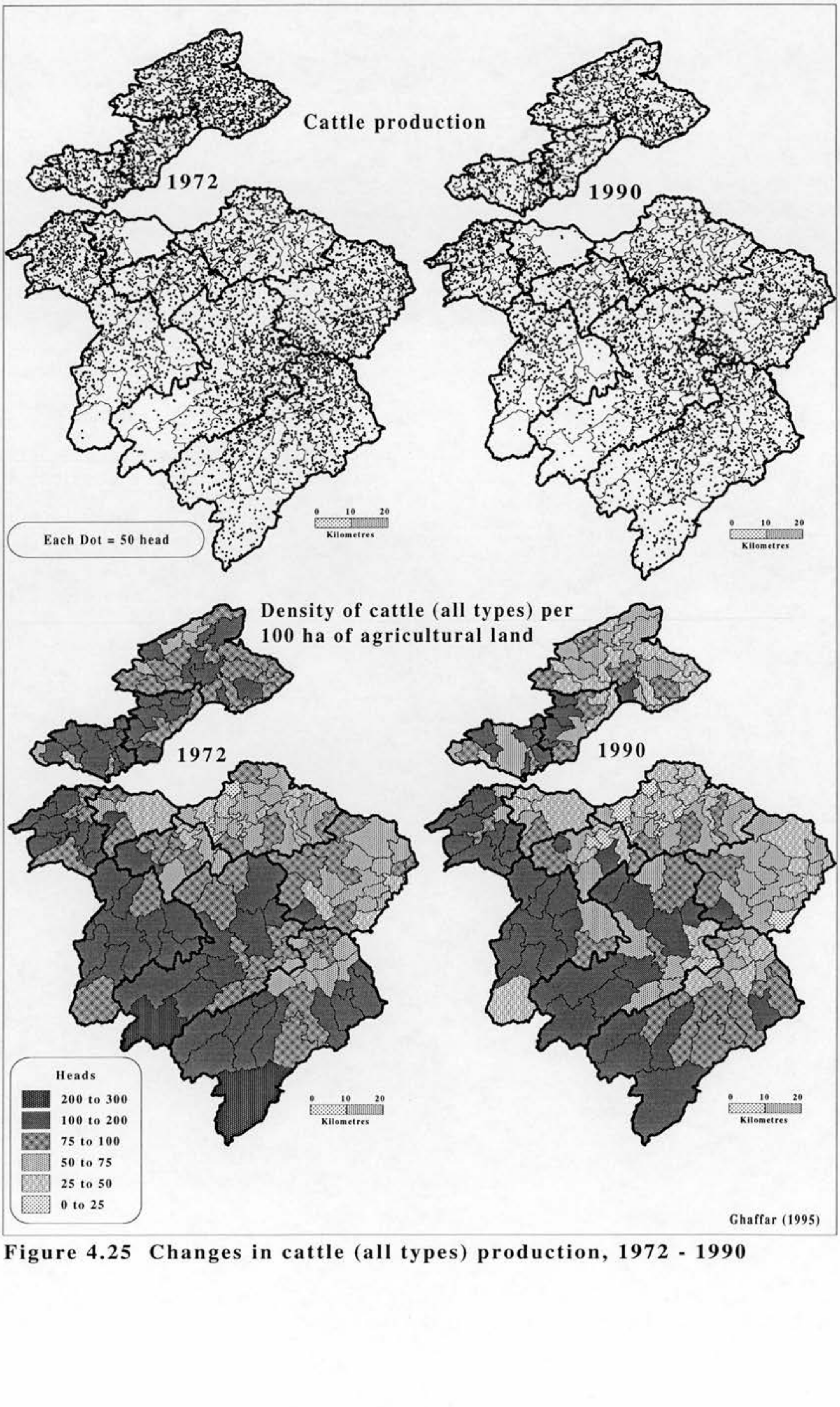


Figure 4.25 Changes in cattle (all types) production, 1972 - 1990

(HLCAs), Suckler Cow Premium Scheme (for beef) and Sheep Annual Premium Scheme (for sheep) rearing have encouraged farmers to increase production though there have been fluctuations during the period 1972 to 1990.

The total number of sheep has increased between 1972 and 1990 (see Table 4.3). Three areas are apparent from Figure 4.24. Ettrick and Roxburgh is the major sheep-producing district in South East Scotland. Berwick and Tweeddale lies between two extremes. A third area, which includes all other districts, produces fewer than 100,000 sheep. A trend of increase in sheep production is evident in all districts. The distribution and change in sheep production can be observed from Figure 4.26. The density of total sheep production per 100 ha of agricultural land has also changed greatly. Some parishes have shifted in sheep density from 500-1000 sheep/ha to 1000-5000. These patterns reflect CAP support for sheep farming via different subsidies (Sheep Annual Premium Scheme). Bowler (1985) has suggested that Variable Premiums and HLCAs have encouraged the localization of production in upland areas of the UK. This view would appear to find support in the tendency towards localised concentration of sheep production in South East Scotland between 1972 and 1990.

The total number of pigs has decreased from 110,185 to 84423 (-23.38%) between 1972 and 1990 (Table 4.3). Pig density per 100 ha of agricultural land in South East Scotland has decreased from 32 to 24 in this period. Figure 4.27 shows changes in pig production in the districts. There have been shifts in all districts, but a notable change is evident in Dunfermline where pig production increased from 10,000 to 40,000 between 1972 and 1980 and then decreased to less than 10,000 in 1990. Figure 4.28 describes the changing patterns of concentration of pig production in the parishes. Pig density per 100 ha of agricultural land has decreased in North-East Fife, Dunfermline, West Lothian and City of Edinburgh districts.

There has been little change in poultry production in South East Scotland (Table 4.3), but Figure 4.27 reveals local and distinct variations (Kirkcaldy, West Lothian and Ettrick) during the period 1972 to 1990. In 1972, there were two major areas of poultry production in Kirkcaldy and West Lothian (Figure 4.29) but by 1990

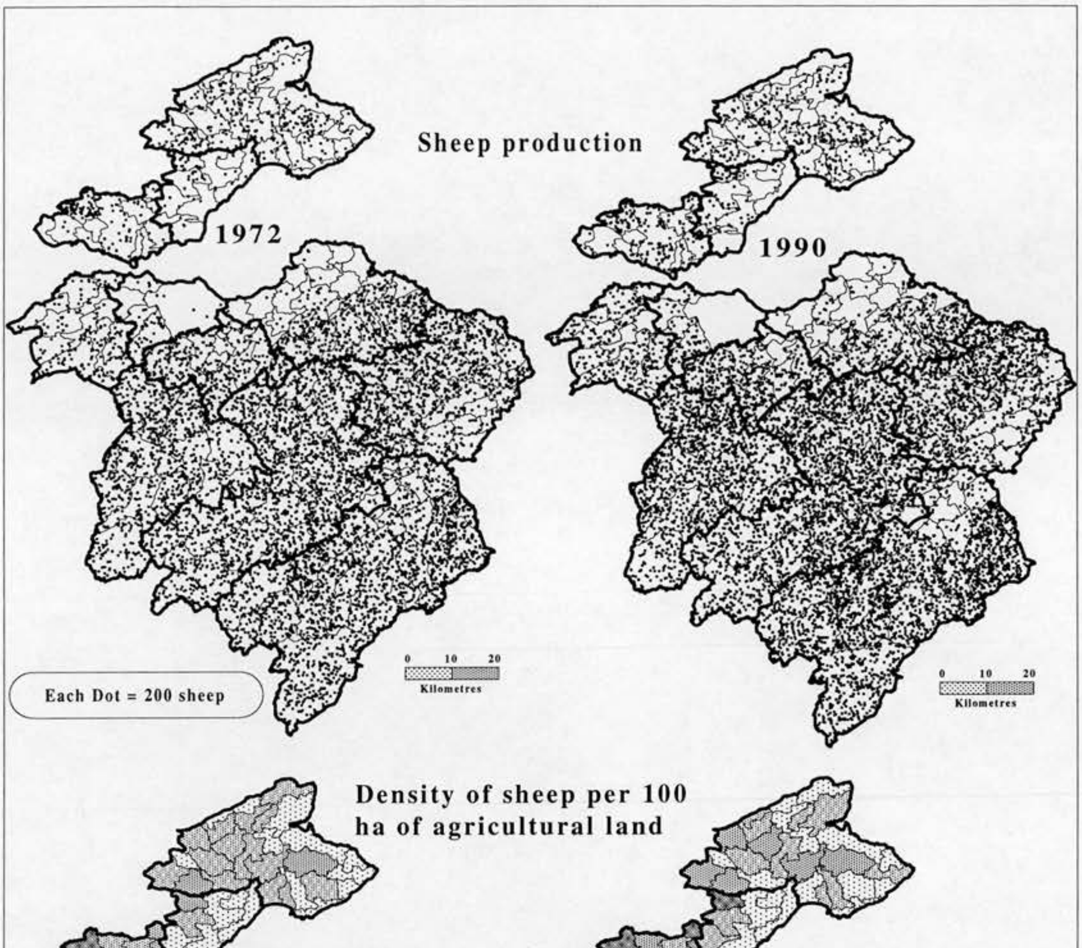


Figure 4.26 Changes in sheep production, 1972 - 1990

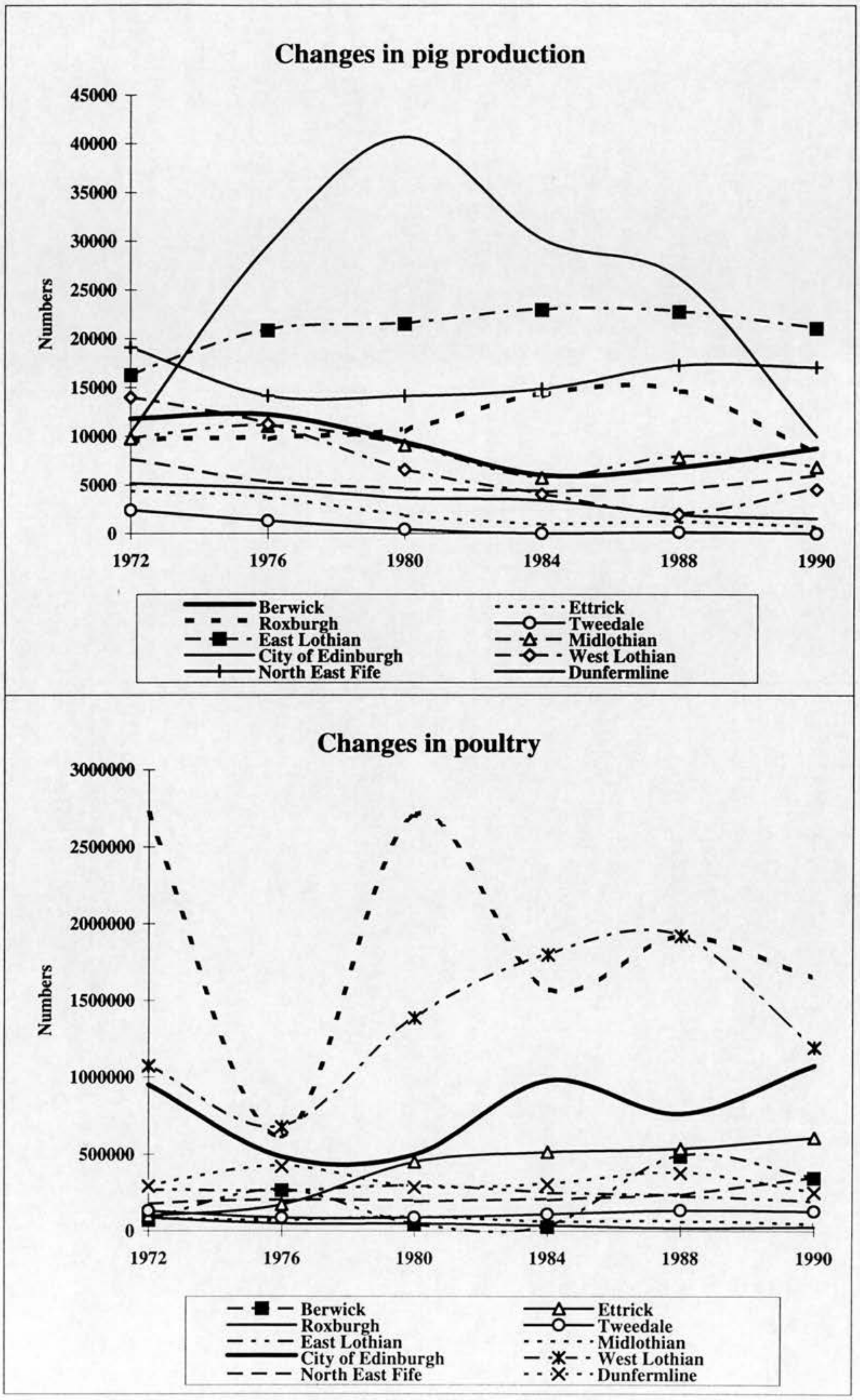


Figure 4.27 Changes in pigs and poultry in districts

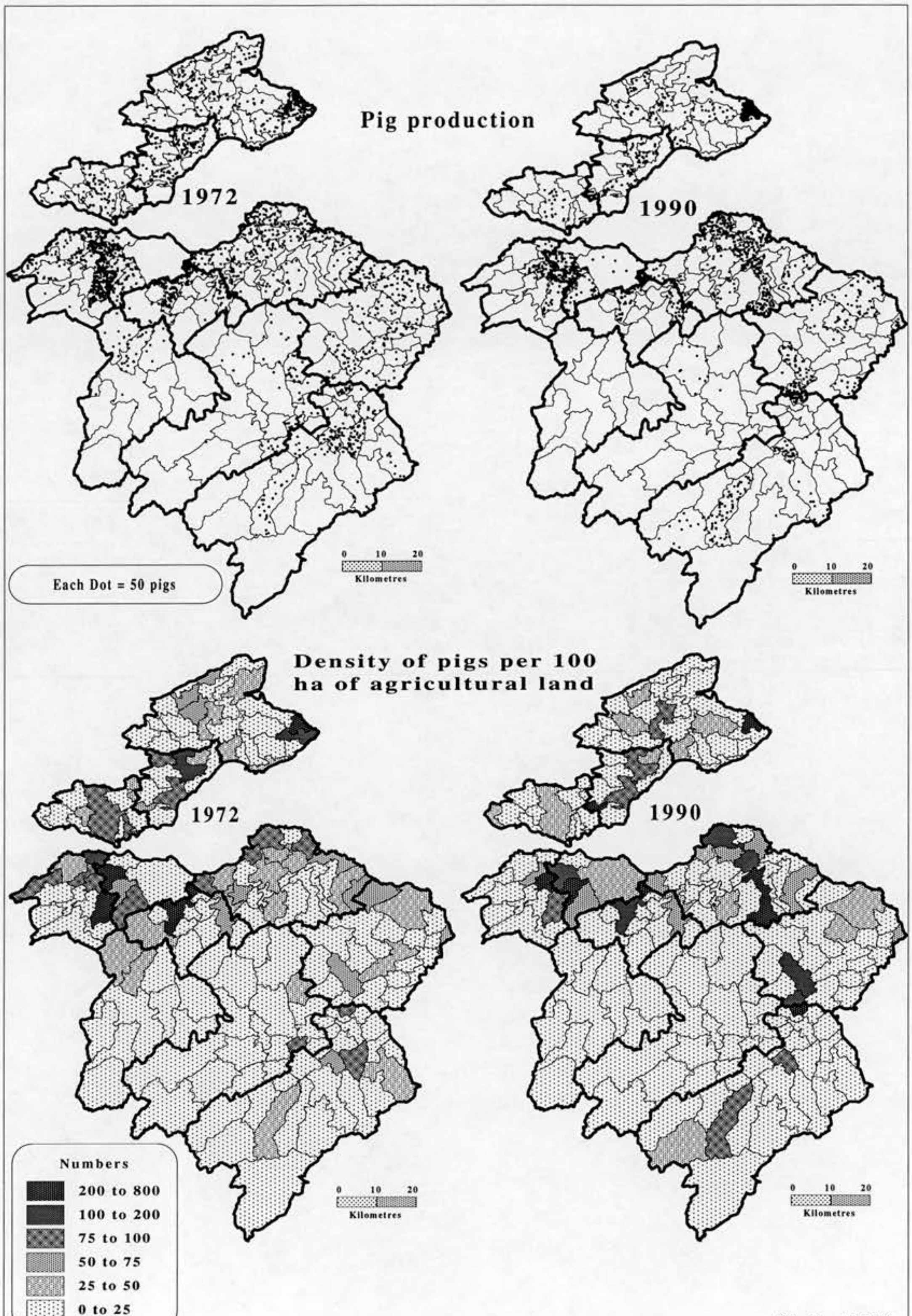


Figure 4.28 Changes in pig production, 1972 - 1990

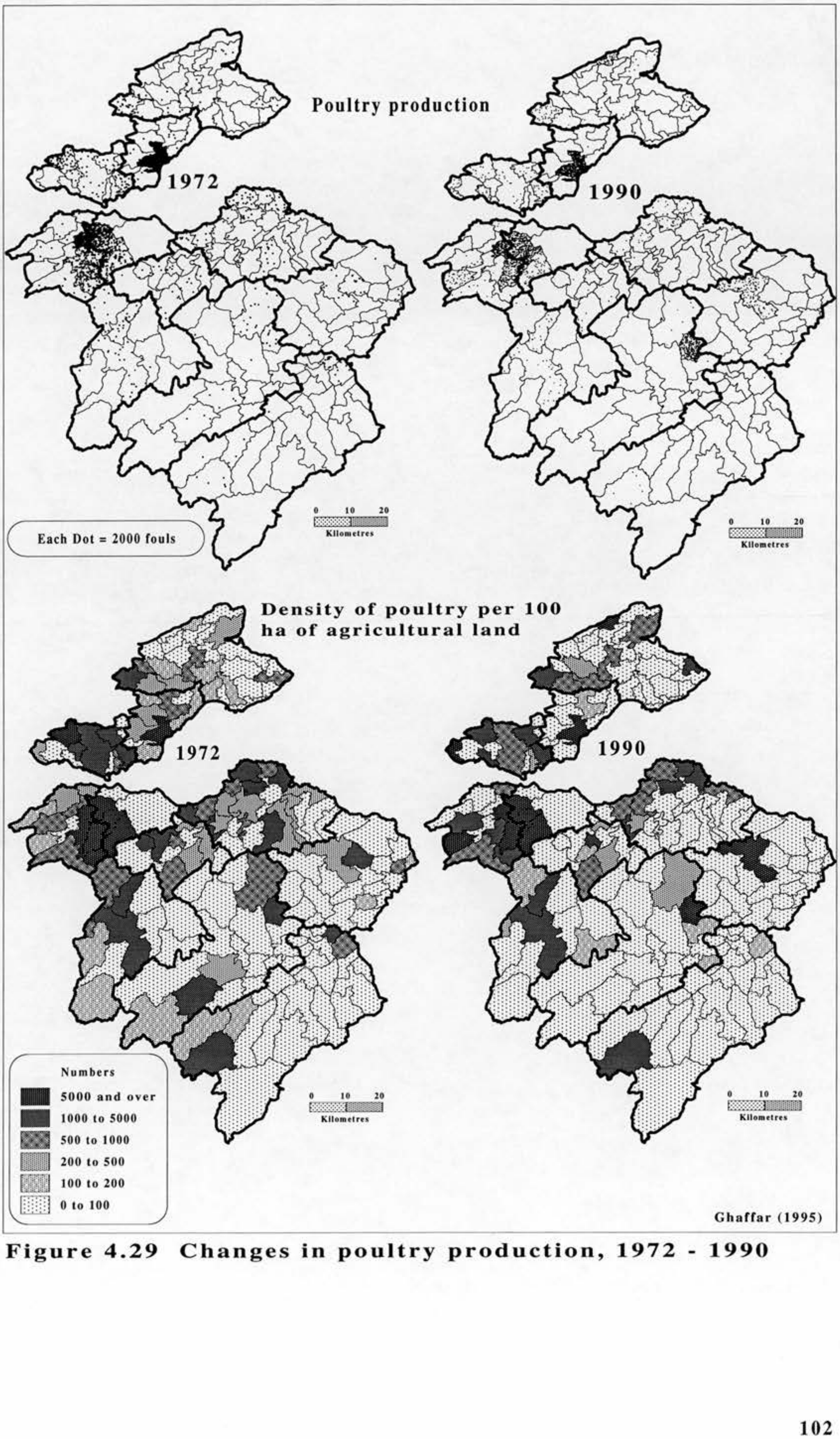


Figure 4.29 Changes in poultry production, 1972 - 1990

a few new areas of higher production had appeared in Ettrick, Berwickshire and North East Fife. There has been little change in the density of poultry production per 100 ha of agricultural land in the parishes between 1972 and 1990 (Figure 4.29).

Figure 4.30 shows multivariate analysis of farming types in the parishes. The clusters of agricultural activities describe changes in the cropping patterns in 1972 and 1990. Beef cattle production was principally part of the areas under grass for mowing, but fell also within the areas under grass not for mowing in 1972. This pattern is also found in 1990 showing the dependence of beef cattle production on grasslands. The area under rough grazing and sheep production has been an integral agricultural activity in parishes with major area under rough grazing in both 1972 and in 1990. Sheep production and the area under rough grazing reflect their relation with areas not suitable for arable purposes. The area under woodland has been a part of the parishes mainly producing grass, oats and beef cattle in 1972. In 1990, after the shift of oats from grass-producing parishes to cropping cluster, farm woodland became the major activity after beef cattle production. Wheat, barley and potatoes were in one main cluster in 1972, especially wheat and barley (the main crop combination) with potatoes a secondary crop. A major change occurred in this crop combination pattern by 1990. Wheat and oilseed rape emerged as the main crop combination and barley as a secondary crop replacing potatoes which moved from cropping cluster to livestock (pigs, dairy cattle and poultry). A shift of potato production from the cropping cluster to the livestock cluster is mainly because of intensification of wheat and oilseed rape in cropping parishes and intensification of potato production in dairy cattle-producing parishes in 1990. On the other hand, oats production has shifted from the beef cattle producing cluster to the crop producing cluster in 1990, specifically to a minor position in relation to barley production. This is because of a decrease in beef cattle production and increase in the area under wheat and oilseed rape in the parishes as discussed earlier. Dairy cattle, pig and poultry production have shown some changes. Dairy cattle, pigs and poultry were in one main cluster in 1972, especially pigs and dairy cattle in one sub-cluster. Pig production moved from dairy

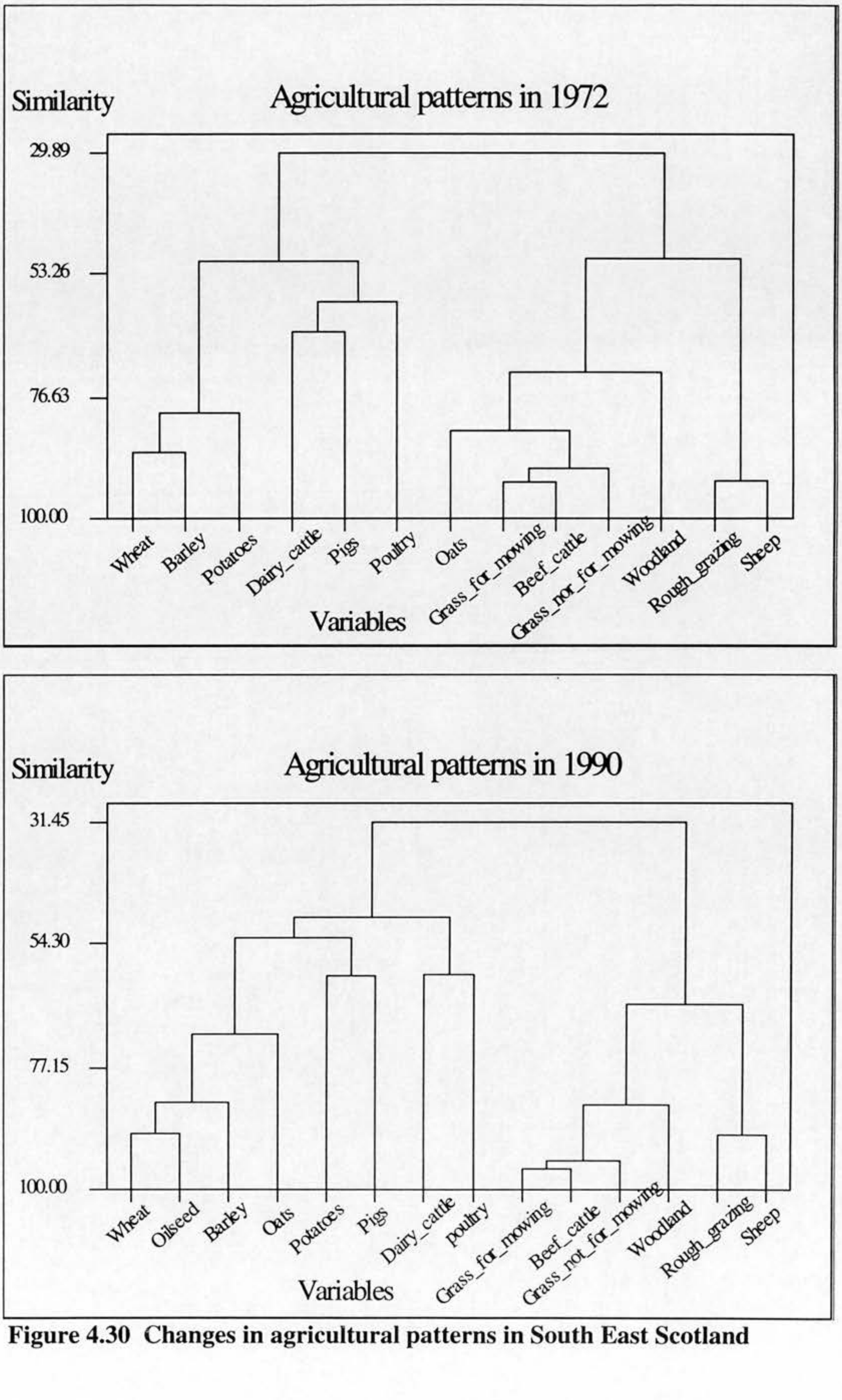


Figure 4.30 Changes in agricultural patterns in South East Scotland

cattle producing areas to potato-producing areas while poultry production has shifted from an individual entity to dairy cattle-producing areas in 1990.

4.3 FARMERS' RESPONSES TOWARDS AGRICULTURE, RURAL LANDSCAPE AND THE CAP

The postal questionnaire survey used, carried out in September 1993, parallels the assessment of agricultural and rural landscape change based on the Agricultural Returns and aerial photography. The questionnaire survey data were categorised into 12 farming types based on the farmers' responses and recognition of their farms' activity. The total area covered by the questionnaire data is 64,148 ha under 284 farms in the area (Figure 4.31). These farms are widely dispersed throughout Lothian and the major part of Fife. All parishes are predominantly arable and arable/stock-producing.

Table 4.4 shows the patterns of land use in the area. Among all farming types, arable farming is the main agricultural activity. Arable farms hold a big share (96 farms) of the total number of farms. About 63 farms are intensive livestock farms, and most of the other farms are mixed farms with crop production dominant. Arable and mixed arable farms cover about 56,000 ha of the study area.

The farm size structure in the study area can be seen in Table 4.4. Most of the farms in all the farming types are greater than 100 ha. The highest number of farms (63) are between 200 to 299.9 ha, most of them intensive arable farms. The largest farms, above 500 ha, are intensive livestock farms, a fact which reflects the intensification and specialisation of livestock. Most farms (172) are wholly owned by the farmers. Farms wholly rented by the farmers are in intensive arable or intensive livestock farming. Most of the part-owned/rented farms (40.8%) are in arable farming. A total of 263 out of the 284 farms are full time; of the part-time farms, most are arable. The farms in the study area are almost all a family business. The majority of the corporate business farms are in arable and stock farming (Table 4.4). Male labour is higher than female labour on arable and mixed arable farms but female labour is higher than male labour on stock-producing farms. These figures represent the arable part of South East Scotland (Figure 4.1). These parishes have

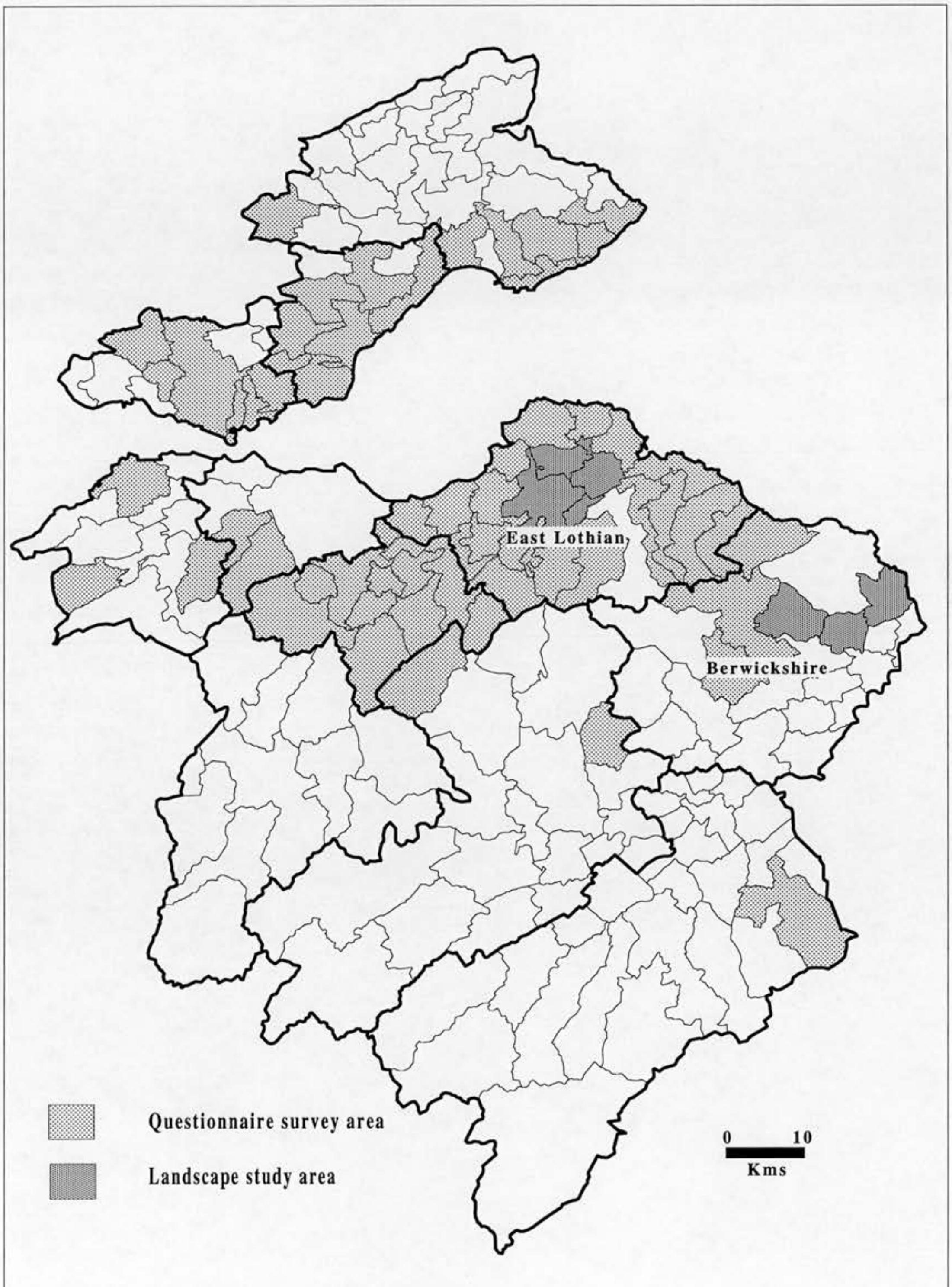


Figure 4.31 Questionnaire survey area

Table 4.4 Patterns of land use in South East Scotland (Farm types)

	Arable	Arable/beef	Arable/dairy	Arable/sheep	Arable/Stock	Beef	Dairy	Pigs	Poultry	Sheep	Stock	Stock /arable	Total
Farms	96	42	10	11	41	7	3	2	1	14	37	20	**284**
Area	15202	9607.9	2245.4	2337.2	9352.83	1059	282	5.9	58	5115.5	11827.2	7055.7	**64148.64**
Fields	602	277	74	46	288	45	4	2	1	90	282	84	**1795**
W. owned	57	27	6	6	24	5	1	2	1	10	20	13	**172**
W. rented	19	7	2	4	11	0	1	0	0	2	14	3	**63**
Part O/R	20	8	2	1	6	2	1	0	0	2	3	4	**49**
Full time	83	42	10	11	40	7	3	2	1	11	34	19	**263**
Part time	13	0	0	0	1	0	0	0	0	3	3	1	**21**
Family	90	40	9	11	40	6	2	2	0	13	35	18	**266**
Corporate	6	2	1	0	1	1	1	0	1	1	2	2	**18**
Total permanent Labour													
Male	243	132	40	26	112	26	10	5	5	31	86	79	**795**
Female	24	24	5	1	9	4	0	0	7	7	14	16	**111**
a. Family members													
Male	133	73	16	17	69	7	4	3	1	21	54	29	**427**
Female	17	14	3	1	7	2	0	0	1	3	9	7	**64**
b. Others													
Male	110	59	24	9	43	19	6	2	4	10	32	50	**368**
Female	7	10	2	0	2	2	0	0	6	4	5	9	**47**
c. Full time (inc. a & b)													
Male	218	122	40	21	106	26	10	5	1	26	78	75	**728**
Female	6	15	3	1	6	2	0	0	1	3	9	7	**53**
d. part time (inc. a & b)													
Male	25	10	0	5	6	0	0	0	4	5	8	4	**67**
Female	18	9	2	0	3	2	0	0	6	4	5	9	**58**
Farm size structure													
1 - 49.9	12	0	0	1	2	1	0	2	0	1	3	1	**23**
50 - 99.9	18	2	1	1	6	3	2	0	1	3	7	1	**45**
100 - 149.9	21	10	1	3	10	0	0	0	0	1	3	4	**53**
150 - 199.9	14	10	4	1	8	2	1	0	0	2	2	1	**45**
200 - 299.9	23	12	2	2	9	0	0	0	0	3	6	6	**63**
300 - 499.9	7	6	1	3	3	1	0	0	0	0	7	4	**32**
500 and above	1	2	1	0	3	0	0	0	0	4	9	3	**23**
Farm woodland													
woodland	28	22	3	5	17	1	1	0	0	4	15	12	**108**
Conifers	19	18	1	3	12	2	0	0	0	5	18	13	**91**
Broadleaved	30	11	3	5	12	1	0	0	0	2	13	13	**90**
Mixed	34	23	4	5	14	3	1	0	0	8	17	10	**119**

Source: Questionnaire survey

shown great changes in agricultural production between 1972 and 1990. These figures also suggest that a majority of the farms are arable and mixed arable in the study area.

Intensification of crops has been acknowledged as one of the consequences of the CAP. Table 4.5 represents the trends of intensification of major crops by the farmers in the area. Wheat has been the main focus of intensification. About 50% of farmers have intensified wheat production while 30% have intensified barley and oilseed rape. This trend would tend to support the evidence of higher increase in the area under tillage, cereals, wheat and oilseed rape extracted from agricultural change analysis. Crop production has been one of the main activities on the farms (172 farms) along with increased field drainage (165 farms) and field amalgamation (137 farms). All three activities are major determinants of the intensification of agriculture in South East Scotland. The questionnaire examined suggests that farmers have improved their field drainage system, via the Farm and Horticulture Capital Grants Scheme (1974), the Agriculture and Horticulture Development and Grant Scheme (1980) and the Agricultural Improvement Scheme (1985). A high level of field amalgamation in the study area reflects that evidence for farm and field amalgamation in the form of the decreasing sign of farm holdings and the increasing size of farms in the parishes discussed above.

There is some evidence of livestock intensification in the area (Table 4.5). Concentration on livestock production has been carried out in stock-producing farms or, exceptionally, on arable farms where farmers have carried out livestock production alongside crop production. Pig production is an exceptional case. Production has increased not on pig-producing farms but on arable farms where farmers have sought to diversity. On the other hand, 117 farms increased livestock production especially in arable/beef, arable/stock, and in stock farming. These trends support the changes in sheep- and beef-producing parishes where sheep production has increased and beef production has seen some minor changes between 1972 and 1990. Subsidies for sheep and beef cattle have encouraged farmers to concentrate on

Table 4.5 Intensification of agriculture by farmers

	Arable	Arable/beef	Arable/dairy	Arable/sheep	Arable/Stock	Beef	Dairy	Pigs	Poultry	Sheep	Stock	Stock /arable	Total
Change in area													
Increase	28	18	7	4	17	1	1	0	0	2	5	9	**92**
Decrease	17	3	1	1	4	1	1	0	0	3	3	2	**36**
No change	51	21	2	6	20	5	1	2	1	9	29	9	**156**
Intensification of crops													
Wheat	61	32	6	7	27	2	0	0	0	4	1	10	**150**
Barley	29	12	5	3	13	1	0	0	0	3	4	9	**79**
Oil seed rape	34	16	2	3	19	1	0	0	0	1	2	6	**84**
Potatoes	12	4	0	1	3	0	0	0	0	0	1	0	**21**
Intensification of livestock													
Beef	4	13	3	0	15	4	0	0	0	2	11	8	**60**
Dairy	1	10	5	0	13	4	1	1	0	0	11	6	**52**
Pig	3	1	0	0	0	0	0	0	0	0	0	0	**4**
Poultry	1	0	0	0	0	0	0	0	1	0	0	0	**2**
Sheep	1	2	1	5	10	0	0	0	0	9	17	13	**58**
Field amalgamation	53	26	6	6	20	2	1	0	0	4	7	12	**137**
Increased field drainage	50	28	7	8	25	4	0	0	0	7	18	18	**165**
Intensification of crop production	64	32	8	9	32	1	0	0	0	3	7	16	**172**
Intensification of livestock productio	6	20	7	5	24	5	1	1	0	9	23	16	**117**
Decrese in crop production	14	6	0	1	7	2	2	0	0	5	11	4	**52**
Decrease in livestock production	51	5	1	2	8	1	0	0	0	0	3	1	**72**

Source: Questionnaire survey

their production. In arable farming, 14 of 96 farms decreased crop production, but only 6 farms out of 96 increased livestock production.

The removal of hedgerows and stone walls has been recognised as a major consequence of the intensification of agriculture. In this study, the intensification has occurred in different ways such as, for example, adding new areas to the farms and amalgamation of fields. Table 4.5 shows the changes in the area of farms in the study area since 1973. Although the majority of farms (156) made no change to their total area, 79 farms increased and 36 farms decreased their area since 1973. The high number of field amalgamations (see Table 4.5) also reflect the fact that farmers in the area have removed their field boundaries in order to enlarge their fields. These changes reflect patterns of changing farm size and field size in the area. Most of these changes have occurred on the arable farms, a fact closely related to the intensification of tillage crops and oilseed rape. Table 4.6 lists the nature of field boundaries in the area. Most of the farms have post & wire fences (250), hedgerows (212) and stone walls (195) as field boundaries. The post & wire fence boundary type is present on almost all types of farms, but hedgerows are more associated with arable farms. Post and wire fences and stone walls as a proportion of total farm boundary types are more associated with stock farming than arable farming. Hedgerows have been removed by 71 farmers, either as a part of farm size change or because of the amalgamation of fields. The post and wire boundary has been removed on 83 farms; this boundary has also been replaced by new hedgerows (see below). Stone walls and other boundaries have fewer removals. Most removals of stone walls have occurred in arable and mixed arable farming reflecting a trend that this change is chiefly as a result of farm size change. Among all types of farming, arable farming has seen the greatest removal of field boundaries, a trend related to the intensification of agriculture through field amalgamation (173 farms), and to increases in productivity of land under tillage and other crops especially in land under wheat and oilseed rape. Questionnaire evidence shows that the farmers have utilised the Capital Grant Schemes, offered under the CAP policies, to develop their agricultural land for arable purposes. Farm features (farm buildings, dispersed trees and ponds/wells) have been included in landscape studies as a component of landscape change (Westmacott,

Table 4.6 Patterns of rural landscape in South East Scotland

	Arable	Arable/beef	Arable/dairy	Arable/sheep	Arable/Stock	Beef	Dairy	Pig	Poultry	Sheep	Stock	Stock /arable	Total
Field boundaries in South East Scotland													
Hedgerows	79	33	10	8	33	5	3	1	0	4	19	17	**212**
Stone walls	62	29	7	9	28	3	3	0	0	9	27	18	**195**
Post and wire	81	35	9	11	36	5	3	2	1	13	34	20	**250**
Treeline	29	10	3	2	11	1	0	0	0	1	7	8	**72**
Mixed	30	15	4	4	14	4	1	0	0	3	8	11	**92**
Hedgerows removed	30	14	4	3	11	1	0	0	0	2	2	4	**71**
Stone walls removed	7	6	3	1	2	0	0	0	0	1	4	1	**25**
Post and wire removed	33	18	5	2	12	1	1	0	0	3	5	4	**83**
Treeline removed	6	4	1	0	4	0	0	0	0	0	1	1	**17**
Mixed removed	4	5	0	2	2	0	0		0	0	1	3	**17**
woodland	28	22	3	5	17	1	1	0	0	4	15	12	**108**
The Farm Woodland Scheme	14	10	1	2	6	2	1	0	0	5	7	4	**52**
Farm features in South East Scotland													
Farm building with Res.	8	4	1	0	2	0	1	1	0	2	3	0	**22**
Farm building without Res.	74	23	5	10	26	4	1	1	1	9	19	15	**187**
Dispersed trees	34	19	6	6	15	0	1	0	0	6	14	11	**111**
Pond / Well	32	16	6	8	9	1	1	1	0	6	14	9	**103**
Farm building without Res. removed	9	5	0	0	4	1	0	0	0	0	5	4	**28**
Dispersed trees removed	7	9	1	0	7	0	0	0	0	0	5	5	**34**
Pond / Well removed	3	2	0	1	1	0	0	0	0	0	0	1	**8**

Source: Questionnaire survey

1984; MLURI, 1992), but any emphasis on the removal of farm features has been insignificant as compared with hedgerows and stone walls. The patterns of presence and removal of farm features can be seen in Table 4.6. Farm buildings 'without' residence (187), dispersed trees (111) and ponds/wells (103) are an important part of rural landscape in the area. Most of these farm features are part of arable farms and in arable, arable/beef, stock and stock/arable farming types.

When UK joined the EC in 1973 there were mixed reactions from farmers about the CAP. Table 4.7 shows the first impressions about the CAP from farmers in the study area. Most were neutral and undecided about the implementation and effects of the CAP. Only 62 farmers responded that their first impression was 'Bad', and 64 farmers thought it was 'Good'. In general it suggests that only a small number of farmers were against the CAP.

Since 1973 a number of CAP policies have been offered to the farmers from time to time (Table 4.6). Three schemes in particular have been the focus of participation by farmers here. They are the Capital Grants Schemes (Farm and Horticulture Development Scheme (FHDS), the Agriculture and Horticulture Development Scheme (AHDS) and the Farm & Conservation Grant Scheme (F & CGS)), the Farm Woodland Scheme and the Set Aside scheme (1988). The rate of participation in capital grant schemes (FHDS, AHDS and F & CGS schemes) shows two different patterns. Initially these schemes (the Farm Capital Grant Scheme, 1974; the Horticulture Capital Grant Scheme, 1974; the Agriculture and Horticulture Development Scheme, 1980; the Agriculture and Horticulture Grant Scheme, 1980; the Agricultural Improvement Scheme (EC), 1985) were offered especially for the improvement of farm structure on the basis of a five-year plan. These schemes have been adopted by farmers in order to improve the field drainage system and to buy farm machinery and other capital goods for the improvement of farms. The participation of farmers in these schemes has accelerated intensification of production in agriculture. Later, revised or alternative schemes (the Agricultural Improvement Scheme (national), 1985; and the Farm & Conservation Schemes, 1989) were offered to improve the environmental and landscape aspects of farms with an emphasis upon planting hedgerows, stone walls, post & wire fences and so on. These schemes have improved the farm landscape at a time when other factors were working to remove field boundaries. Blunden and Curry (1988) note that these schemes have been helpful in improving the rural landscape. The majority of those participating in the Farm Woodland Scheme, especially on arable farms, reflects both the trend of planting new woodland to improve the rural landscape in the study area, and the incentives of price support. Since 1988, when price support policies were changed, farmers have been offered different schemes for not cultivating some of their arable land. The highest participation rates have occurred in adoption of the Set Aside Scheme (1988) and the Woodland Scheme, almost all in the study area on arable and mixed arable farms. Since the Set Aside Scheme was completely on a voluntary basis, it may be reasonably said to reflect the true picture of farmers' responses towards the incentive. Later this scheme was converted to a 1993 Set Aside Scheme under which farmers were bound to set 15% of their land aside for fallow or other purpose (Robinson, 1993). Table 4.7 shows the farmers' responses in the study area toward three major schemes offered since 1988. A large number of farmers (181) disliked the Set Aside Scheme. Only 27 farmers considered the scheme 'good'. Responses towards the Farm Diversification Scheme and the Farm Extensification Scheme have not been significant. The majority of the farmers who disliked the Set Aside Scheme are arable farmers. The Farm Diversification Scheme (1989) was offered to encourage investment in farm-based, non-agricultural enterprises, offering capital grants and support for feasibility studies and marketing. Only 29 farmers considered this scheme 'bad' and 92 farmers considered the Farm Diversification Scheme 'good'. Only 30 farmers considered the Farm Extensification Scheme 'good'; 60 regarded it as 'bad'. A large majority was neutral and or undecided. This may mean either that they saw no value to these schemes or they could not decide upon their efficacy so remained neutral. Those farmers who regarded them as 'good' policies saw clear advantage in adopting the policies. The Farm Extensification Scheme (1989) has been offered for sheep and beef farmers to encourage a reduction in their production by 20% over five years.

Table 4.7 Patterns of farmers' responses towards the CAP

	Arable	Arable/beef	Arable/dairy	Arable/sheep	Arable/Stock	Beef	Dairy	Pig	Poultry	Sheep	Stock	Stock /arable	Total
First impression about CAP													
Bad	24	9	4	1	8	2	2	1	0	2	5	5	**63**
Good	19	8	2	5	9	1	0	0	0	4	11	5	**64**
Neutral	33	15	3	2	17	1	0	0	0	6	11	6	**94**
Undecided	20	10	1	3	7	3	1	1	1	2	10	4	**63**
Participation of farmers in govt. schemes													
The 1973 Farm Amalgamation Scher	2	0	0	0	1	0	0	0	0	0	0	0	**3**
FHDS, AHDS, or F & CGS Schemes	43	29	8	5	29	3	1	0	0	6	22	12	**158**
Pig Subsidy Scheme	0	0	0	0	1	0	0	1	0	0	0	0	**2**
The Farm Woodland Scheme	14	10	1	2	6	2	1	0	0	5	7	4	**52**
Set Aside Scheme (introduced 1988)	40	19	2	3	13	1	1	0	0	3	2	5	**89**
The Farm Diversification Scheme	2	2	1	0	0	1	0	0	0	0	0	0	**6**
The Rural Enterprise Programme	0	0	0	0	0	0	0	0	0	0	0	0	**0**
The Farm Extensification Scheme	1	1	0	0	3	0	0	0	0	0	3	1	**9**
Set Aside Scheme (introduced 1988)													
Bad	58	28	7	4	28	5	2	1	0	12	27	9	**181**
Good	12	3	0	4	3	1	1	0	0	0	0	3	**27**
Neutral	23	7	3	2	9	1	0	0	0	1	8	5	**59**
Undecided	3	4	0	1	1	0	0	1	1	1	2	3	**17**
The Farm Diversification Scheme													
Bad	9	3	0	0	6	1	0	0	0	2	5	3	**29**
Good	34	8	4	4	13	4	2	1	0	5	11	6	**92**
Neutral	28	14	3	4	14	0	1	0	0	2	13	7	**86**
Undecided	25	17	3	3	8	2	0	1	1	5	8	4	**77**
The Farm Extensification Scheme													
Bad	8	2	1	0	7	3	0	0	0	3	3	3	**30**
Good	20	8	4	3	5	0	1	0	0	4	10	5	**60**
Neutral	36	17	3	4	19	1	2	1	0	4	13	8	**108**
Undecided	32	15	2	4	10	3	0	1	1	3	11	4	**86**
Change of price support policies													
Bad	47	17	5	4	24	2	1	1	0	5	15	11	**132**
Good	10	6	2	5	4	0	1	0	0	4	9	3	**44**
Neutral	28	15	3	2	10	4	1	0	0	3	10	4	**80**
Undecided	11	4	0	0	3	1	0	1	1	2	3	2	**28**

Source: Questionnaire survey

Farmers' responses towards the current change in price support in comparison with their responses at the time of accession to the EC (1973) may suggest a major change in farmers' behaviour about the CAP. The total number of farmers in favour of the CAP increased from 64 to 132 in the period under review as compared to 62 who disliked the CAP policies in 1973. The large number who were neutral or undecided in 1973 had reduced to a small group in 1988, most of them involved in arable and mixed arable farming.

Figure 4.32 shows a cluster analysis of the variables on the basis of the questionnaire survey. Farmers were asked to describe their activities with reference to agricultural intensification. Three patterns of cluster can be seen. The decrease in the farm area and the farms with no change in the area are in one cluster showing no significant relation with agricultural intensification. Increased field drainage has been the only activity carried out on the farms under this cluster. Stock intensification is an isolated variable showing the nature of this activity. The questionnaire survey data comprises the crop-producing parishes of Fife and Lothian regions. The absence of any relation between stock intensification and major determinants of agricultural intensification shows that stock intensification is only carried out on the livestock-producing farms. The major cluster of variables consists of area increased by the farmers, wheat intensification on the farms, field amalgamation, oilseed rape production, crop intensification, and increased field drainage. All these variables are highly inter-related in the cluster, but within this major cluster, small clusters of different variables showing strong correlation can be seen in Figure 4.32. Wheat intensification is highly correlated with field amalgamation, clearly reflecting the process of enlarging field size on the farms, especially for the intensification of wheat. Oilseed production is highly dependent on the intensification of crops in the farms. Farmers have been producing oilseed rape at the expense of other crops, chiefly oats, barley and potatoes. Some farmers have intensified barley production, especially in conjunction with wheat intensification and field amalgamation. The area increased by the farmers is highly associated with all these variables (wheat intensification, field amalgamtion, oilseed rape and crop intensification).

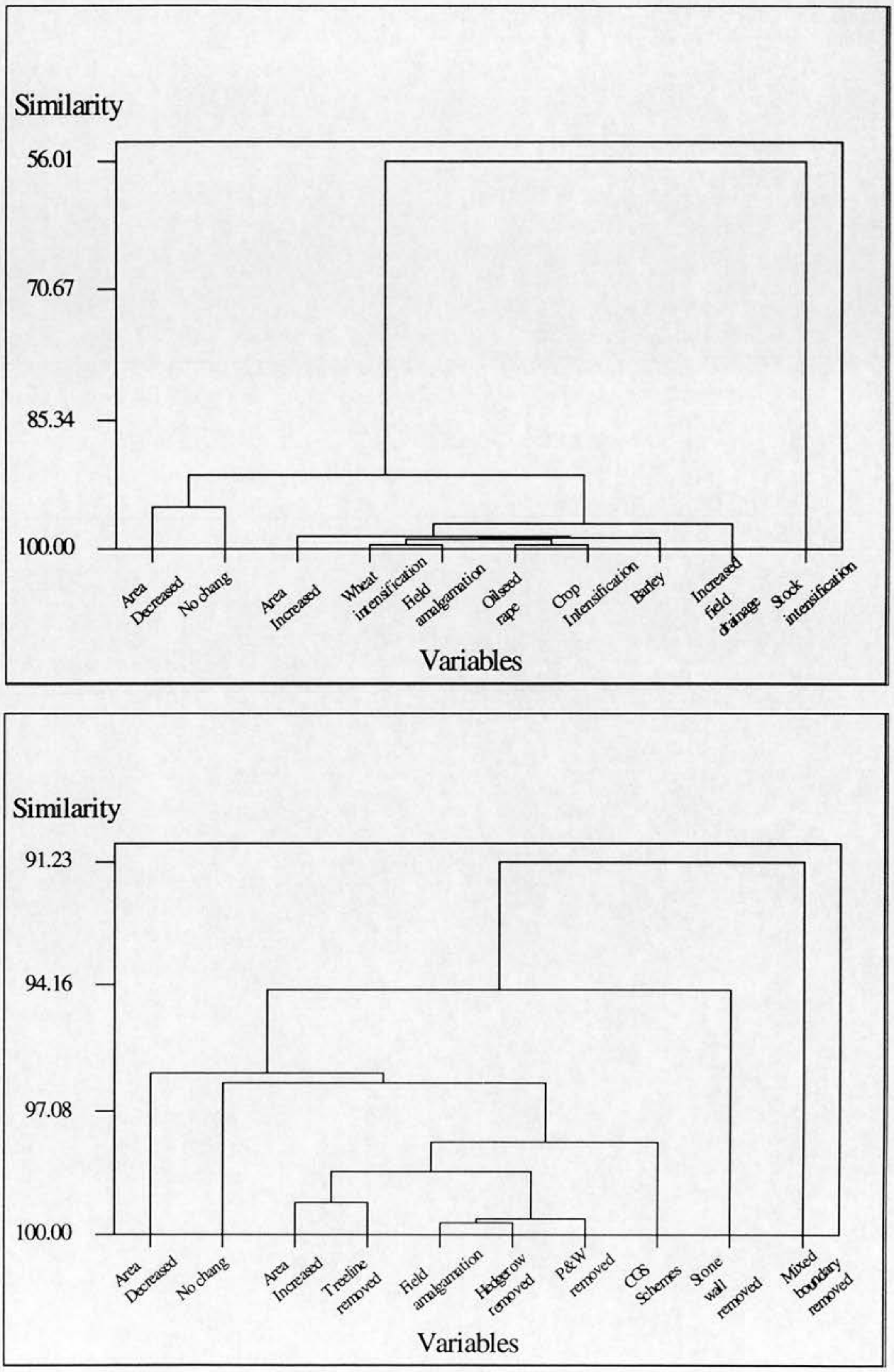


Figure 4.32 Farmers' responses to agriculture and rural landscape

This activity clearly explains how the area of the farms has been increased in order to increase farm productivity. Increased field drainage has been carried out on almost all those farms which have participated in the intensification of agriculture. These patterns of cluster analysis strongly support that other evidence revealed here on the changing patterns of agriculture in South East Scotland based on the Agricultural Returns and an aerial photograph analysis for civil parishes which have shown great changes in area under wheat and oilseed rape, and increase in the average farm size.

The farmers' responses towards agricultural intensification and rural landscape features show that changes in the rural landscape have been highly associated with agricultural intensification (Figure 4.32). The relations among these variables show that removal of tree-line boundaries has been dependent upon the increase of the farm area. The removal of hedgerow boundaries is highly dependent upon field amalgamation on the farms whereas removal of post & wire fence boundary is associated with field amalgamation and hedgerow removal. The removal of hedgerows has provided additional land to farmers for the intensification of crops through enlargement of fields as discussed earlier. The Capital Grants Schemes are related to field amalgamtion, increased area, tree-lines, hedgerows and post & wire fences boundaries removals, reflecting the impact of such schemes on agricultural intensification and changes in the rural landscape.

4.4 SUMMARY

This chapter has outlined the changes in agriculture in South East Scotland between 1972 and 1990. Farm holdings have decreased in size and in number in almost all parishes, though an increase has been evident in some parishes after 1988. Great change has occurred in land tenure patterns. A decrease has been evident in areas owned by farmers and in areas rented from outside concerns, but the area rented from near relatives has increased, especially in livestock-producing parishes and in the uplands (Tweeddale, Ettrick and Lauderdale). The area owned by the farmers has increased in crop-producing areas, especially in North East Fife and East Lothian. The total area of agricultural land has increased. The area under woodland has increased in most parishes. The area under grass for mowing and grass not for mowing has decreased in arable parishes, but, for the former, has increased in sheep- and cattle-rearing areas. Most of the parishes which do not have high quality land have increased their area under grass reflecting a concentration on farm livestock. A greater change has occurred in the area under tillage and cereals in the parishes. Among major crops, the area under wheat and oilseed rape has increased. A major decrease (72.39%) has occurred in the area under oats.

Changes in farm livestock are notable. Dairy and beef cattle decreased between 1972 and 1990, though there have been fluctuations within districts and parishes at different periods of time. The total number of cattle has decreased by 16.32%. Their density (per ha of agricultural land) has decreased from 91 to 74 head. Sheep production has increased (26.87%). This higher density of sheep has occurred in almost all parishes especially in those parishes where land quality for agriculture is poor and limited to grassland and rough grazing. A decrease is also apparent in pig and poultry production where production is limited to a few parishes (though it has begun areas in some additional parishes.

The decrease in farm holdings between 1972 to 1988 is mainly due to factors arising from adoption of incentive schemes (the Farm Amalgamation Scheme 1973) and the Farm Structure (Payments to Outgoers) Scheme 1976). Additionally, landlords have been taking back land from tenants to keep under their own management, especially in arable areas. This has resulted in an increase in the area owned by farmers (Bowler 1985). The decrease in farm holdings has resulted in an increase in farm sizes in the area. The increase in farm holdings since 1988 is because of the Farm Diversification Scheme (1988) and the Set Aside Scheme (1988) under which emphasis was given to convertion of the productive agricultural land into non-arable purposes. Bowler (1992) noted that farmers have been selling some of their land as 'hobby farms' to urban migrants. Whilst it is possible that the facts of familial change are important in influencing shrinkage of holdings, it is also true that the increase in areas rented from a near relative in sheep and beef-producing areas reflects farmers in that sector deciding not to continue the farming practice and renting their land to near relatives. Bowler (1985) has also suggested that farmers may prefer to rent the land instead of buying new land for intensification of agriculture.

Even allowing for the fact that the study area has spatial variations in its relief, soil and climate, the area under tillage has increased in all parishes reflecting an intensification of crop production. This increase is mainly due to a decrease in areas under grass and rough grazing. Parishes which for the first time put land under tillage between 1972 and 1990 obviously show a very high percentage change. There have been great changes within tillage, especially in cereal crops. Areas under wheat and oilseed rape have increased at the expense of oats, barley and potatoes, mainly because of high prices for wheat and oilseed rape as compared to barley, oats and potatoes. The price for wheat has risen three-fold between 1970 to 1980, for barley about two-fold, and oats has remained less than wheat. The main reason for the increase in the oilseed rape is its price which has encouraged farmers to put more land under oilseed rape. An increase in the area under cereals has been a major feature of agricultural change in the community under the CAP (Bowler, 1985: 112). The Farm Woodland Scheme has encouraged farmers to put more land under woodland. Reforms in milk prices and in the quota system have led to a reduction in dairy cattle. The average yield of a dairy cow has continued to rise (1.4% a year), despite a fall in the number of producers and the gradual decline in the number of dairy cows (0.2% a year). Subsidies (Hill Livestock Compensatory Allowances (HLCAs), Suckler Cow Premium Scheme for Beef, and Sheep Annual Premium Scheme (for sheep rearing) have encouraged farmers to increase production although there are fluctuations during the period 1972 to 1990. Bowler (1985) has noted that financial assistance under the Suckler Cow Premium of the CAP for keeping breeding cows, and the HLCAs, has served to maintain the concentration of beef breeding in the upland areas. EC sheepmeat regulations (1980) have proved a general stimulus to sheep production. Variable premiums and HLCAs have served to encourage the localization of production in upland areas of the study area, as others have noted for elsewhere in the UK (Bowler, 1985).

On the whole, the area under agricultural land and livestock production has increased. The bases to intensification of production are evident from farmers' responses who have intensified their crop and livestock production through increased field drainage and field amalgamation, by buying new land, and by participating in capital grant schemes. The intensification, concentration and specialization of agriculture has led in the area to a greater industrialization of agriculture. "The CAP, for example, has maintained many agricultural prices at such favourable levels as to encourage and sustain excess production for the domestic market. In addition, the intervention system within the EC has provided, in effect, a limitless market for all the major agricultural products" (Bowler, 1992: 14).

CHAPTER 5

RURAL LANDSCAPE CHANGE IN EAST LOTHIAN

5.1 INTRODUCTION

In chapter 4 the general patterns of agricultural change in South East Scotland were examined. In this chapter, rural landscape change in the East Lothian sample area is examined along with the details of agricultural change and the farmers' responses in the sample parishes.

5.2 STUDY AREA

The study area consists of four civil parishes: Athelstaneford, Haddington, Morham, Prestonkirk. The combined area of these parishes is 8327 ha, and the area covered by the questionnaire survey is 4942 ha. Figure 5.1 describes the landscape of the study area: it is chiefly under 60 metres above mean sea level with a few areas up to 200 metre above sea level. The soils of the area belong to two groups (Table 5.1); brown forest soil with gleying on drumlin-like ridges and noncalcareous and humic gleys in channels. The soils are slowly permeable to moisture and natural drainage is generally imperfect. The second group of soils belongs to brown forest soils with gleying and some brown forest soils. The soils are developed on water-modified tills with sandy upper layers underlain by sandy-clay-loam till. These soils form some of the best agricultural land in the area and have few limitations to sustained intensive arable farming. Figure 5.2 shows the soil types in the sample parishes. There are 11 types of soils in the area with minor differentiations in their characteristics. Three types of soils have been found in most parts of the sample area. Soil type 331 occurs in 80% of the area of Athelstaneford and Prestonkirk, is found in some parts of Haddington, and in a very small part of south-east Morham. Another major soil is type 466 covering the whole of Morham parish and some of Haddington. The third soil type, 444, occurs in the greater part of Haddington. Other soil types have a dispersed pattern throughout the parishes.

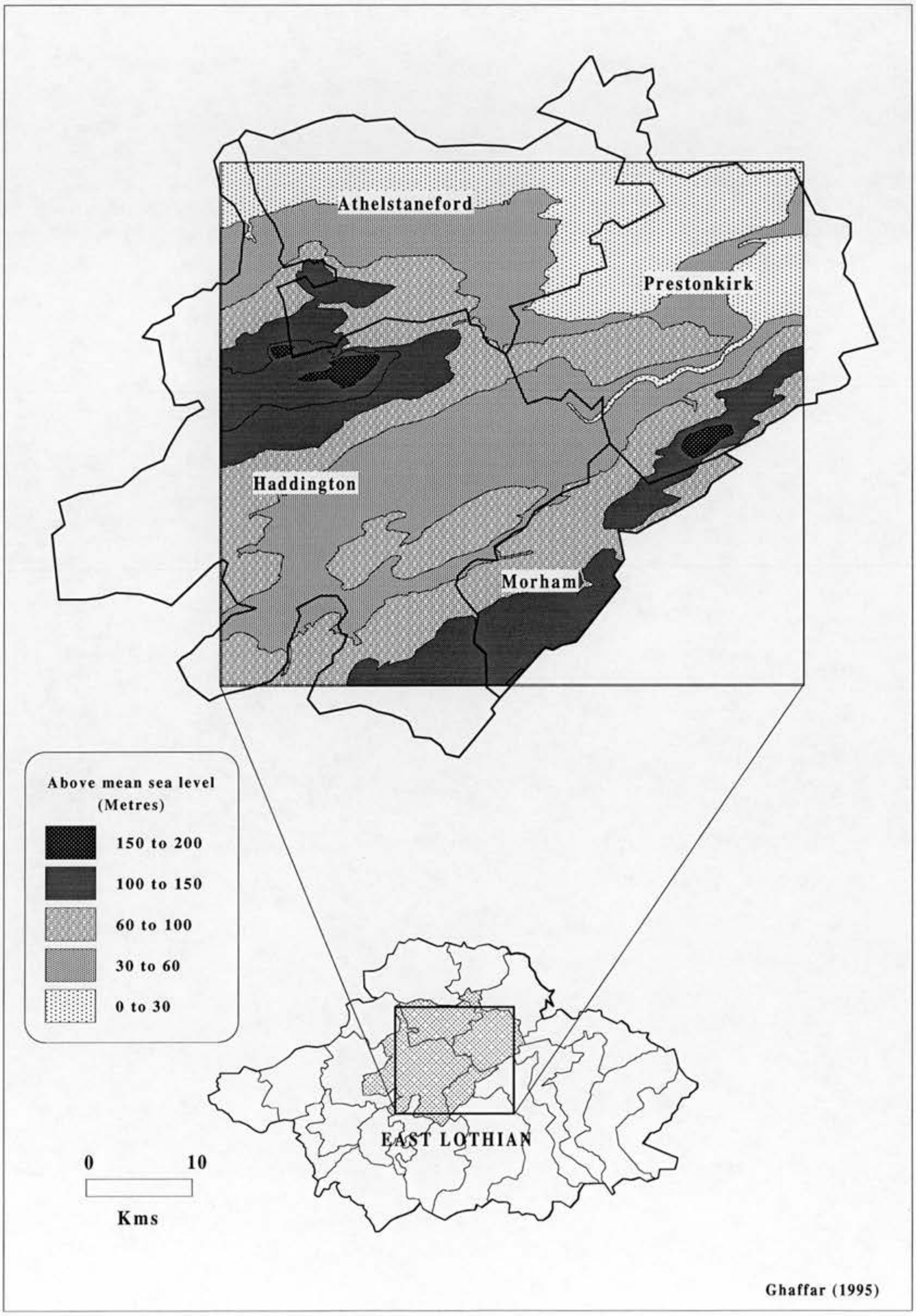


Figure 5.1 Rural landscape study area in East Lothian

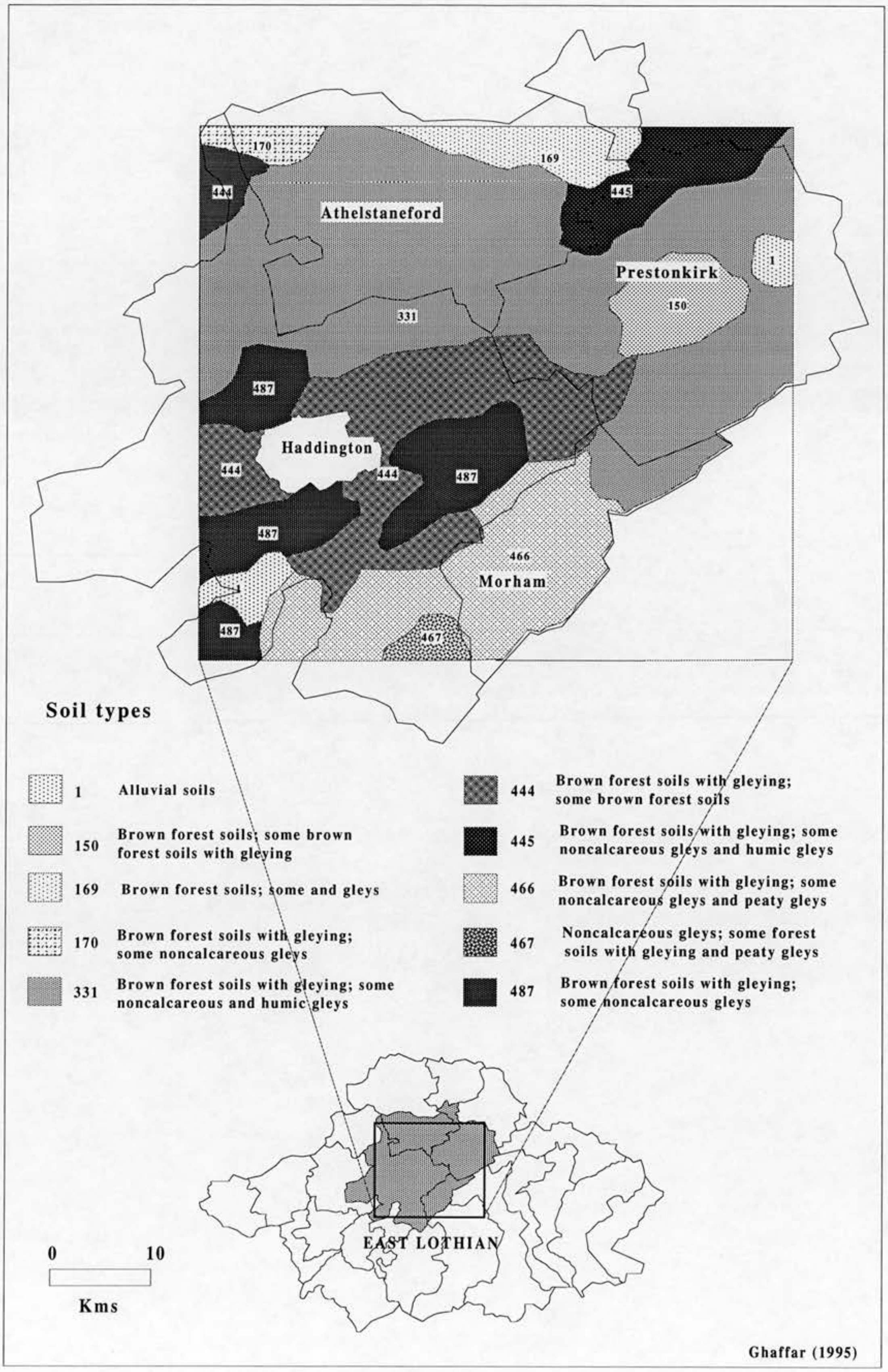


Figure 5.2 Soil types in East Lothian sample area

On the basis of land capability for agriculture, the area comes under class 2 and 3. Figure 5.3 shows the land capability for agriculture in the parishes. The whole of Athelstaneford, a major part of Haddington and some of Prestonkirk has type 2 land capability, the second best land for agriculture in Scotland. The whole of Morham parish and some of Haddington and Prestonkirk is under 31 land capability for agriculture. Cropping is very flexible and the level of yield is high. Most of Prestonkirk is under 32: capable of producing consistently high yields of a narrow range of crops (principally cereals and grass) and moderate yield of a wide range (including potatoes, field beans and other vegetables and root crops).

5.3 AGRICULTURAL CHANGE

These parishes lie in 'the heart' of arable South East Scotland. The period 1973 to 1988 has seen tremendous changes in land use. Due to CAP structural policies, changes have been found in the number of farm holdings in the sample areas: notably a decline by 23% in East Lothian during the period 1973 to 1988, allowing for variations between the sample parishes.

Table 5.1 shows the number of farm holdings in the sample area. The total has decreased between 1972 and 1990 with the greatest changes occurring in Haddington. Similar patterns have appeared in other parishes. In Athelstaneford, farm holdings reduced from 36 to 24 and in Prestonkirk from 23 to 21. Morham is the only parish with no change. A reducing number of farm holdings between 1972 and 1988 reflects the amalgamation of farms in the area due to agricultural intensification. The area rented from outside concerns and from near relatives has decreased and the area owned by the farmers has increased in the sample parishes (Fig. 4.7). The area owned by the farmers has increased between 0-25% in Haddington, by 25-50% in Morham and by 50-100% in Athelstaneford. This may suggest that a reduction in the total number of farm holdings is due both to a decrease in the area rented and an increase in the area owned by the farmers.

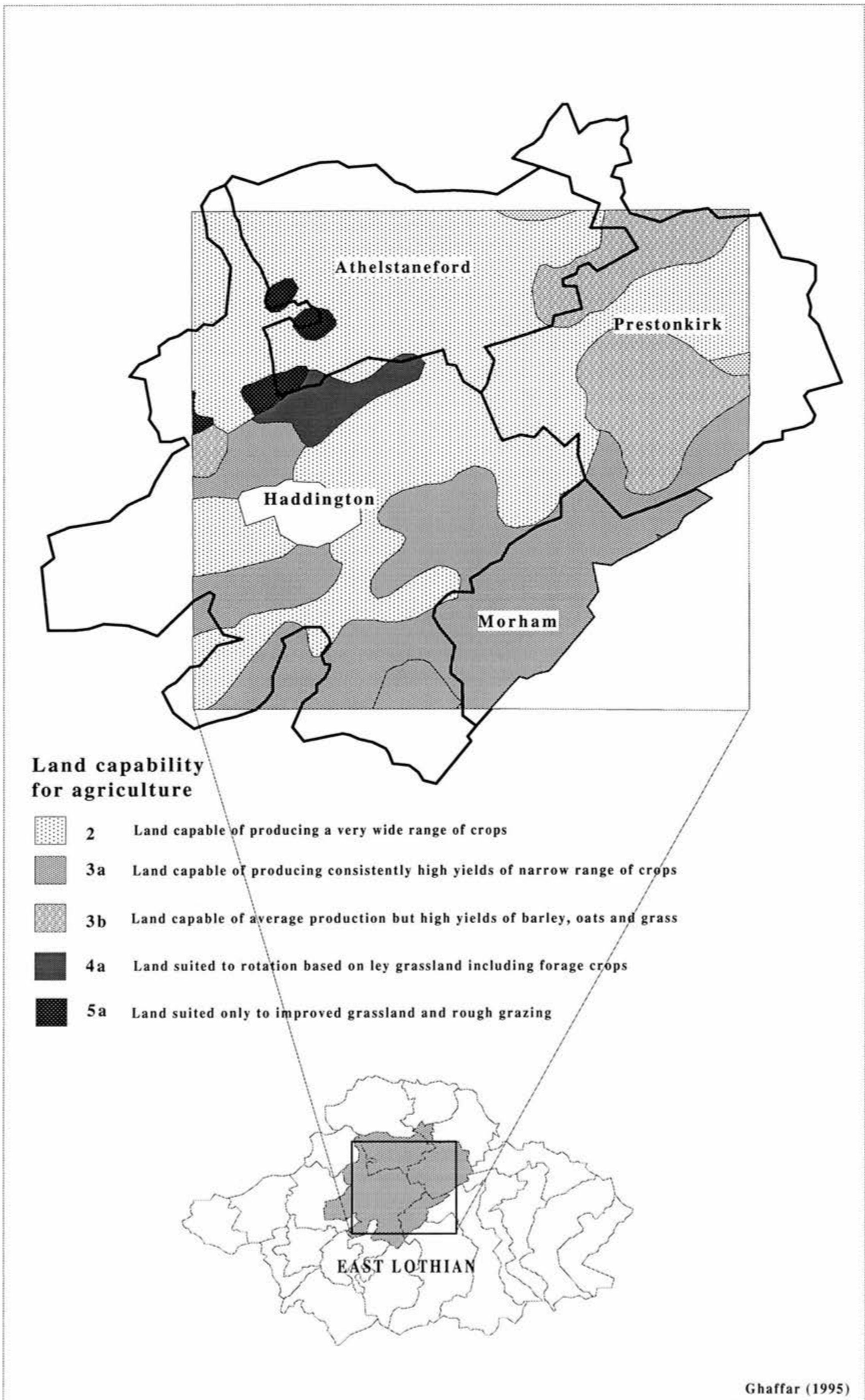


Figure 5.3 Land capability for agriculture in East Lothian sample area

Table 5.1 Farm holdings in sample area, 1972 - 1990

	1972	1976	1980	1984	1988	1990
Athelstaneford	36	34	30	25	24	24
Haddington	79	71	67	63	49	49
Morham	7	7	7	7	7	7
Prestonkirk	23	21	20	19	18	21

Source: Parish summary data

The average farm size in the area has changed as the number of farm holdings have decreased and agricultural land has increased. Average farm size in East Lothian has increased from 83 ha to 100 ha between 1972 and 1990 in spite of a decrease between 1988 and 1990 (Figure 4.8). Average farm size in the parishes has also increased on the whole. It increased in Athelstaneford and Haddington from less than 50 ha to more than 50 ha. In other parishes average farm size remained in the same category though a change has occurred in their farm sizes.

5.3.1 Crops, Grass and Rough Grazing

Table 5.2 shows changes in the area under crops, grass and rough grazing. Generally, wheat, all cereals, oilseed rape, tillage, arable and agricultural land has all increased between 1972 and 1990. The area under grass for mowing and not for mowing, rough grazing, barley, oats and potato has decreased in the same period. Some reduction has occurred in the area under tillage, arable and agricultural land in some of the sample parishes between 1988 and 1990. The area under wheat has increased except in Haddington where it decreased from 1499.4 ha to 1366.6 ha between 1988 and 1990. Oilseed rape, which increased from 1984 when it was first sown, decreased between 1988 and 1990. The areas under barley, oats and potatoes have reduced since 1972, although barley is still an important crop in the area. The area under crops, grass and rough grazing has reduced sharply in the parishes.

Figure 5.4 shows the land use changes in the parishes between 1972 and 1990. Great change has occurred in the area under tillage, especially in Athelstaneford and Prestonkirk. The proportion of grass for mowing and rough grazing has reduced sharply in all parishes except Morham. The proportion of grass not for mowing has

Table 5.2 The patterns of land use in East Lothian sample parishes (ha)

Athelstaneford

	Wheat	Barley	All Cereals	Oilseed Rape	Tillage	Arable	Grass for mowing	Grass not for mowing	Rough Grazing	Agricultural land
1972	346	573.4	992.4	0	1316.5	1311	135.1	143.2	33.2	1595
1980	324.6	778.7	1106.3	0	1397.9	1372.8	79.2	67.6	31	1583.5
1988	548.4	136.6	691.8	72.9	1601.9	1588.9	69.8	119.1	14.2	1790.8
1990	637	74	713.8	8.5	1419.6	1417.3	28.3	65.4	13.8	1513.3

Haddington

	Wheat	Barley	All Cereals	Oilseed Rape	Tillage	Arable	Grass for mowing	Grass not for mowing	Rough Grazing	Agricultural land
1972	492.3	1534.7	2242.5	13.4	2717.3	2697.4	314.1	816.5	161.8	3847.9
1980	896.2	2085.8	3021.6	16.7	3502	3496.1	298	637.2	46.5	4545.9
1988	1499.4	374.2	1927.1	317.8	3450.5	3433.1	124.4	373.6	45.8	3948.5
1990	1366.6	348.9	1742.6	0	3357.9	3154.4	131.1	311.3	99.6	3800.3

Morham

	Wheat	Barley	All Cereals	Oilseed Rape	Tillage	Arable	Grass for mowing	Grass not for mowing	Rough Grazing	Agricultural land
1972	124.3	225.4	402.2	0	459.1	457.1	153.8	127.5	13.9	740.6
1980	144.6	248.7	447.8	0	495.7	490	145.7	83.9	16.7	740.1
1988	197.5	35.5	233	22.1	553.1	552.1	24	158.7	18.7	735.8
1990	279.4	12.4	291.8	0	546.8	536.3	121.8	58.9	13.6	727.5

Prestonkirk

	Wheat	Barley	All Cereals	Oilseed Rape	Tillage	Arable	Grass for mowing	Grass not for mowing	Rough Grazing	Agricultural land
1972	366.1	909.5	1394.7	13.4	1738.1	1736	529.8	176.9	109.4	2444.7
1980	487.2	1251.1	1763.6	19.3	2041.9	2039.6	167	170.7	92.1	2380
1988	828.9	270.3	1127.5	131.4	1870.7	1868.7	115.3	125.7	67.7	2111.7
1990	1034.4	213.8	1254.8	0	2059	2052.6	113	124.4	52.2	2296.4

Source: Derived from Agricultural Returns

* Agricultural land includes all crops, fallow and grassland, but excludes rough grazing.
Therefore the proportion under arable, grassland and rough grazing does not sum to 100%.

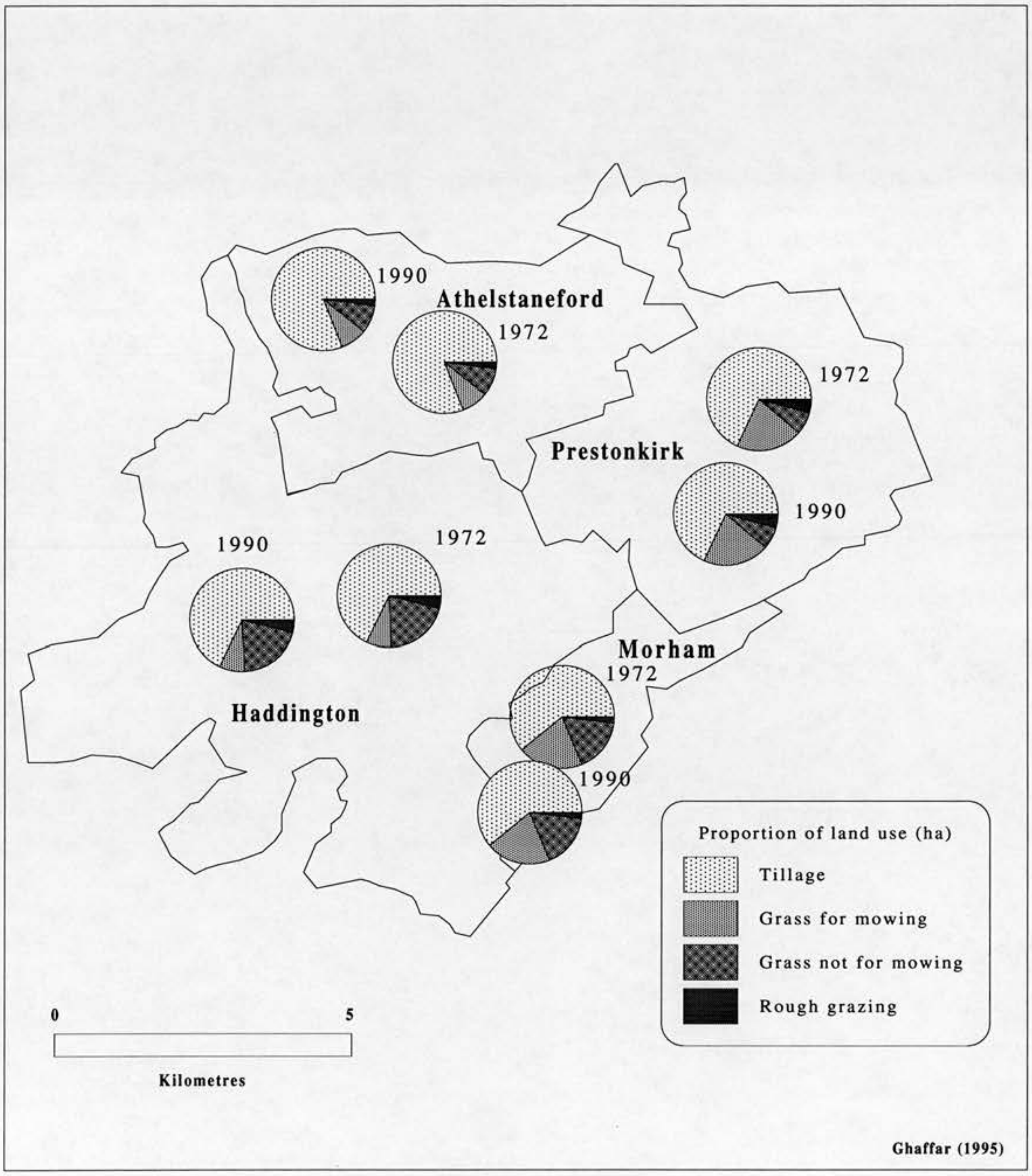


Figure 5.4 Proportional change in land use between 1972 and 1990

also reduced in all parishes except Prestonkirk where only a minor change has occurred.

Figure 5.5 shows the changes in the proportion of the area under major crops. A high increase can be seen in the area under wheat and oilseed rape in all parishes, due to intensification, in turn the result of high prices. Oats has almost disappeared in all parishes. A reduction can be seen in barley and potato. Wheat and oilseed rape have increased at the expense of barley and oats. Table 5.3 shows land use as percentage of agricultural land where agricultural land includes all crops, fallow and grassland but excludes rough grazing. Tillage and arable land use has been a major percentage of agricultural land since 1972. The percentage of wheat in agricultural land has increased greatly in all parishes making it almost 50% of agricultural land. Barley and oats have reduced to a very small proportion. Oilseed rape increased its share between 1984 and 1988 but fell between 1988 and 1990. Cereals have decreased their share, mainly due to the decrease in barley and oats. Major change has also occurred under the area of grass and rough grazing.

5.3.2 LIVESTOCK CHANGE

Table 5.4 shows livestock change in the area. There has been a reduction in the production of dairy and beef cattle in all parishes. A very sharp reduction from 5643 to 1818 in sheep production has occurred in Haddington between 1980 to 1988. Pig production has increased (from 690 to 2928) in Prestonkirk but declined in Haddington. In Morham, all types of livestock have been reduced except dairy cattle and pig (never produced in Morham). Poultry production has declined in all parishes except Athelstaneford where it has increased more than 100%. Figure 5.6 shows the changes in major livestock. The total number of cattle (all types) has increased in Haddington and Morham but has decreased in other parishes. The proportion of pigs in Haddington has remained the same in spite of its reduction in the total numbers. (Table 5.4). The proportion of sheep has reduced in Haddington and Prestonkirk but has increased in Athelstaneford. Figure 5.7 shows the proportion of dairy and beef cattle against other livestock. The proportion of dairy and beef cattle has reduced to a

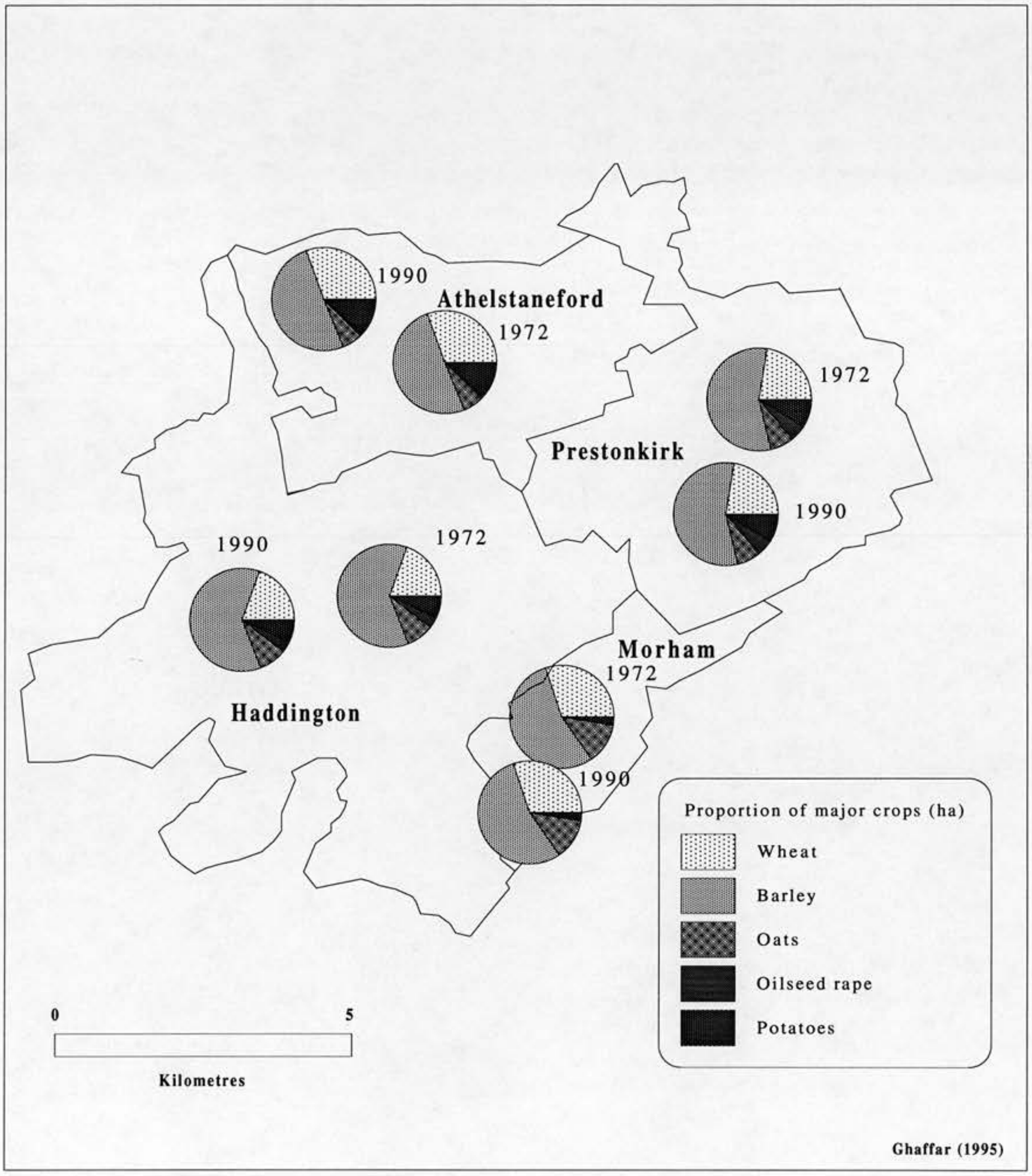


Figure 5.5 Proportional change in major crops between 1972 and 1990

Table 5.3 Land use as a % of Agricultural Land*

Athelstaneford

	Wheat	Barley	All Cereals	Oilseed Rape	Tillage	Arable	Grass for mowing	Grass not for mowing	Rough Grazing
1972	21.69	35.95	62.22	0.00	82.54	82.19	8.47	8.98	2.08
1980	20.50	49.18	69.86	0.00	88.28	86.69	5.00	4.27	1.96
1988	30.62	7.63	38.63	4.07	89.45	88.73	3.90	6.65	0.79
1990	42.09	4.89	47.17	0.56	93.81	93.66	1.87	4.32	0.91

Haddington

	Wheat	Barley	All Cereals	Oilseed Rape	Tillage	Arable	Grass for mowing	Grass not for mowing	Rough Grazing
1972	12.79	39.88	58.28	0.35	70.62	70.10	8.16	21.22	4.20
1980	19.71	45.88	66.47	0.37	77.04	76.91	6.56	14.02	1.02
1988	37.97	9.48	48.81	8.05	87.39	86.95	3.15	9.46	1.16
1990	35.96	9.18	45.85	0.00	88.36	83.00	3.45	8.19	2.62

Morham

	Wheat	Barley	All Cereals	Oilseed Rape	Tillage	Arable	Grass for mowing	Grass not for mowing	Rough Grazing
1972	16.78	30.43	54.31	0.00	61.99	61.72	20.77	17.22	1.88
1980	19.54	33.60	60.51	0.00	66.98	66.21	19.69	11.34	2.26
1988	26.84	4.82	31.67	3.00	75.17	75.03	3.26	21.57	2.54
1990	38.41	1.70	40.11	0.00	75.16	73.72	16.74	8.10	1.87

Prestonkirk

	Wheat	Barley	All Cereals	Oilseed Rape	Tillage	Arable	Grass for mowing	Grass not for mowing	Rough Grazing
1972	14.98	37.20	57.05	0.55	71.10	71.01	21.67	7.24	4.47
1980	20.47	52.57	74.10	0.81	85.79	85.70	7.02	7.17	3.87
1988	39.25	12.80	53.39	6.22	88.59	88.49	5.46	5.95	3.21
1990	45.04	9.31	54.64	0.00	89.66	89.38	4.92	5.42	2.27

Source: Derived from Agricultural Returns

* Agricultural land includes all crops, fallow and grassland, but excludes rough grazing.
Therefore the proportion under arable, grassland and rough grazing does not sum to 100%.

Table 5.4 The patterns of livestock and farm structure in sample parishes

Athelstaneford

	Dairy Cattle	Beef Cattle	Sheep	Pigs	Poultry	Labour	Farm holdings	Agricultural land	Average farm size
1972	147	725	217	705	20887	61	36	1595	44.3
1980	51	459	260	239	23139	79	30	1583.5	52.8
1988	3	679	609	976	42145	71	25	1790.8	71.6
1990	6	480	420	1109	48053	53	24	1513.3	63.1

Haddington

	Dairy Cattle	Beef Cattle	Sheep	Pigs	Poultry	Labour	Farm holdings	Agricultural land	Average farm size
1972	350	1704	5256	1626	8827	149	79	3847.9	48.7
1980	159	1654	5643	1196	1582	190	67	4545.9	67.8
1988	154	1517	1818	1487	507	122	63	3948.5	62.7
1990	137	1521	1073	792	854	109	49	3800.3	77.6

Morham

	Dairy Cattle	Beef Cattle	Sheep	Pigs	Poultry	Labour	Farm holdings	Agricultural land	Average farm size
1972	0	199	604	0	167	22	7	740.6	105.8
1980	0	208	649	0	60	29	7	740.1	105.7
1988	0	157	1461	0	52	26	7	735.8	105.1
1990	0	150	398	0	29	24	7	727.5	103.9

Prestonkirk

	Dairy Cattle	Beef Cattle	Sheep	Pigs	Poultry	Labour	Farm holdings	Agricultural land	Average farm size
1972	353	1277	243	690	1017	99	23	2444.7	106.3
1980	165	1181	19	1757	448	78	20	2380	119.0
1988	204	817	26	2541	59	69	19	2111.7	111.1
1990	41	682	50	2928	78	52	18	2296.4	127.6

Source: Derived from Agricultural Returns

* Agricultural land includes all crops, fallow and grassland, but excludes rough grazing.
Therefore the proportion under arable, grassland and rough grazing does not sum to 100%.

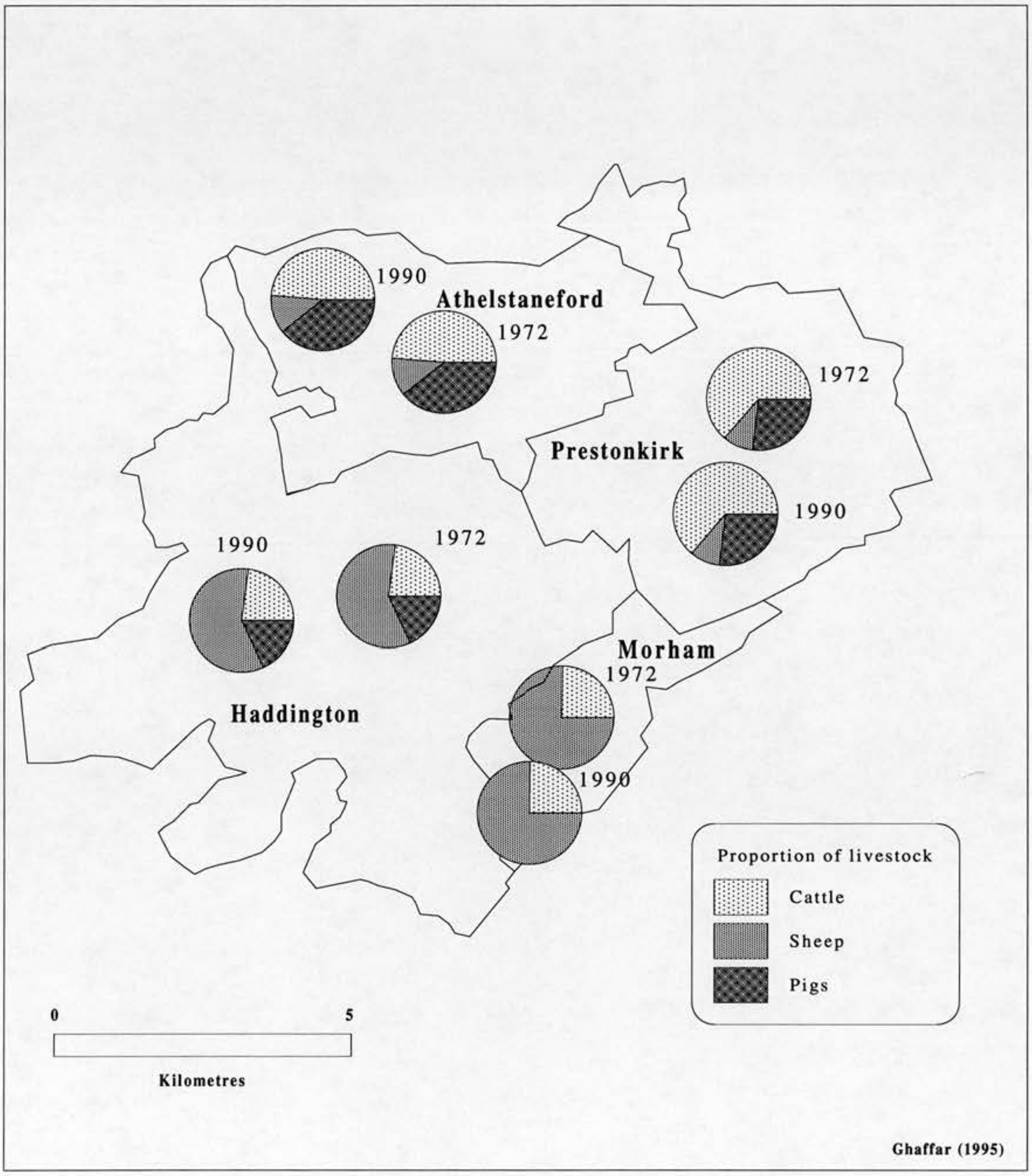


Figure 5.6 Proportional change in livestock between 1972 and 1990

Table 5.5 Changes in Livestock, agricultural Labour and farm Size in sample parishes (numbers per 100 ha of agricultural land)

Athelstaneford

	Dairy Cattle	Beef Cattle	Sheep	Pigs	Poultry	Labour	Average farm size*
1972	9	45	14	44	1310	4	44.31
1980	3	29	16	15	1461	5	52.78
1988	0	38	34	55	2353	4	71.63
1990	0	32	28	73	3175	4	63.05

Haddington

	Dairy Cattle	Beef Cattle	Sheep	Pigs	Poultry	Labour	Average farm size*
1972	9	44	137	42	229	4	48.71
1980	3	36	124	26	35	4	67.85
1988	4	38	46	38	13	3	62.67
1990	4	40	28	21	22	3	77.56

Morham

	Dairy Cattle	Beef Cattle	Sheep	Pigs	Poultry	Labour	Average farm size*
1972	0	27	82	0	23	3	105.80
1980	0	28	88	0	8	4	105.73
1988	0	21	199	0	7	4	105.11
1990	0	21	55	0	4	3	103.93

Prestonkirk

	Dairy Cattle	Beef Cattle	Sheep	Pigs	Poultry	Labour	Average farm size*
1972	14	52	10	28	42	4	106.29
1980	7	50	1	74	19	3	119.00
1988	10	39	1	120	3	3	111.14
1990	2	30	2	128	3	2	127.58

Source: Derived from Agricultural Returns

* Average farm size is not per 100 ha of agricultural land

small proportion in all parishes except Haddington where it has remained constant. The proportion of sheep has increased in Morham but decreased in Haddington. The proportion of pigs has increased in Athelstaneford and Prestonkirk. Table 5.5 shows changes in livestock, agricultural labour, and farm size in the area per 100 ha of agricultural land (as defined above). Dairy and beef cattle have decreased in all parishes. Sheep have increased in Athelstaneford but decreased in all other parishes between 1972 and 1990. In Morham, sheep increased from 82 to 199 between 1972 and 1988, then fell between 1988 and 1990 from 199 to 55. Poultry has increased from 1310 to 3175 per 100 ha in Athelstaneford but has fallen in all other parishes. Farm labour has decreased in all parishes since 1972. Average farm size has increased in all parishes excepting a minor decrease in Morham due to reduction in the area of agricultural land.

5.4 COMPONENTS OF LANDSCAPE CHANGE

The use of machines has prompted field enlargement and the removal of hedgerows and stone walls. In addition, there has been the introduction of new farm buildings for machinery, feed, animals and dairy farms. It has been estimated that a square field of about 20 hectares (around 50 acres) allows the most efficient use of field machinery (Blunden 1985). Edward (1970) and Green (1981) have calculated the impact of removal of hedgerows on the field size. Green (1981) also suggested that with a 2 ha field, 2.6 per cent of the land is under hedgerows (assuming a average width of 2 m).

5.4.1 Field size

In the study area, the total number of fields has reduced from 654 to 555 (a decrease of 101 fields) or a -15.1% change (see Table 5.6) This change has cut the number of fields of less than 15 ha of field size (a reduction of 130 fields) and increased (by 31) the fields from 15 - 100 ha. The highest percentage change, a decrease of 31.2%, has been in fields from 0-4.9 ha of field size. An increase of 66.7% has occurred for fields of between 25 - 29.9 ha. Table 5.7 presents a statistical

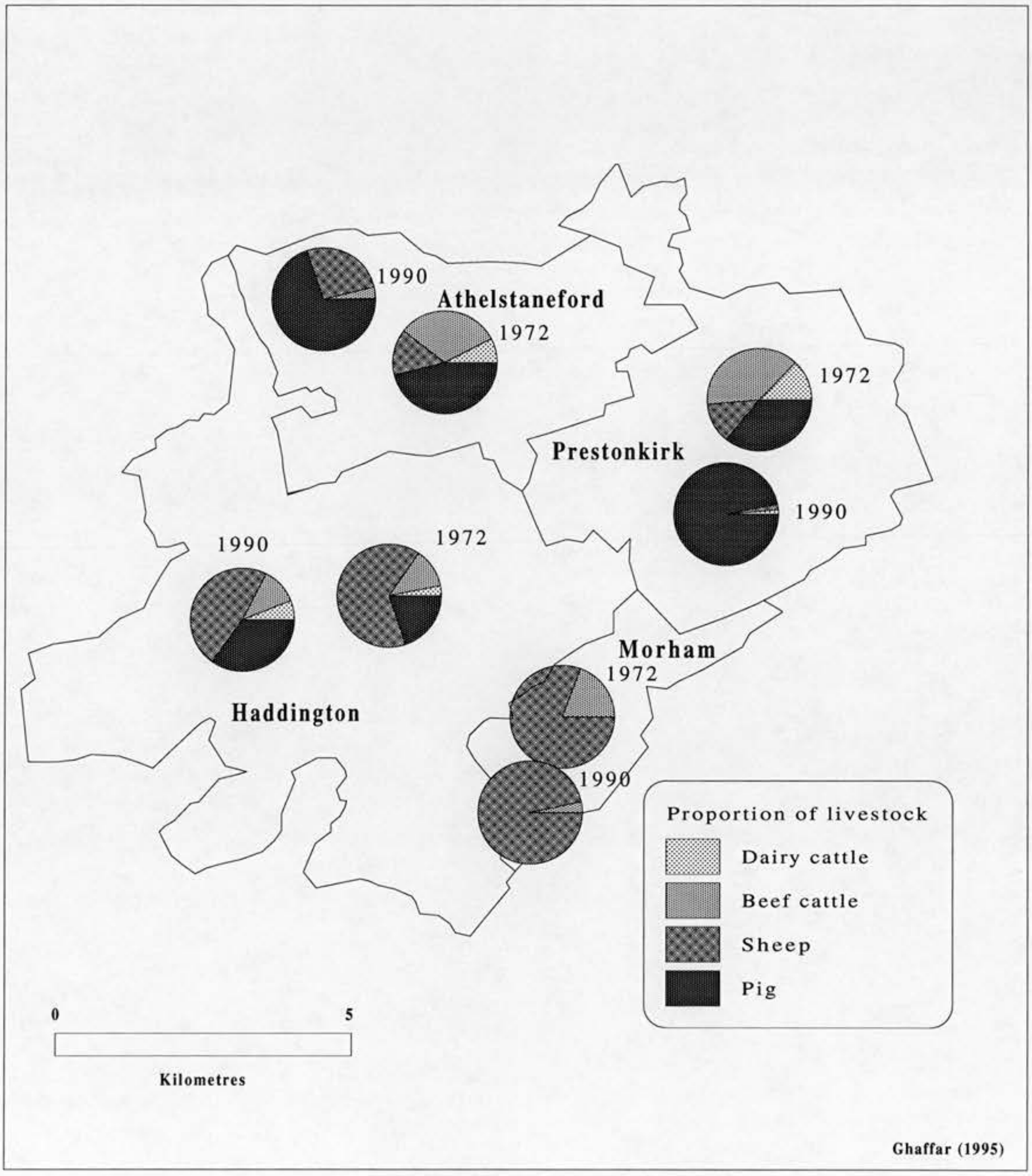


Figure 5.7 Proportional change in major livestock between 1972 and 1990

summary of the number of fields, and the area for the sample parishes covered by the photographs of the area in 1972 and 1988. It highlights a substantial reduction in the number of fields, with the smallest reduction in Morham parish. The highest reduction was in Haddington where there was a decrease from 234 fields to 192 (an 18% reduction). All 42 fields were amalgamated to enlarge field size. In Prestonkirk, the number of fields has decreased from 184 to 148 (-19.52% change), the highest percentage change in all sample parishes. But the highest actual change in the number of fields occurred in Haddington, a reduction of 42 fields compared with 36 fields in Prestonkirk.

Table 5.6 Patterns of change in field size in sample area, 1972 - 1988

Hectares	Number of fields in 1972	Number of fields in 1988	Percentage change
0 - 4.9	144	99	-31.25
5 - 9.9	273	214	-21.61
10 - 14.9	155	129	-16.77
15 - 19.9	49	54	10.20
20 - 24.9	16	24	50.00
25 - 29.9	3	8	166.67
30 - 34.9	7	8	14.29
35 - 39.9	2	8	300
40 - 44.9	4	6	50
45 - 49.9	0	1	100
50 - 69.9	1	3	200
>= 70	0	1	100
Total fields	**654**	**555**	**-15.14**

Source: Rural landscape change data

Table 5.7 Field size change in sample parishes, 1972 - 1988

	Number of fields (1972)	Number of fields (1988)	change 1972-88	% change 1972-88	Area (ha) 1972	Area (ha) 1988
Athelstaneford	142	122	**-20**	-14.1	1353.63	1364.34
Haddington	234	194	**-40**	-18	2203.26	2232.13
Morham	94	91	**-3**	-3.2	751.88	758.06
Prestonkirk	184	148	**-36**	-19.53	1827.81	1947.46
Total change	**654**	**555**	**-99**	**-15.13761**	**6136.58**	**6301.99**

Source: Rural landscape change data

Athelstaneford had a 14.1% reduction through loss of 20 fields. The least change was in Morham with a 3.2% loss, a reduction of only 3 fields. Figure 5.8 shows the change in farm holdings in the parishes. Morham has no change in farm holdings during this period. Field amalgamation is not only dependent, therefore, on amalgamations within individual farms but also depends on selling and buying of land within the process of farm amalgamation. In Morham, which has no change in the number of farm holdings, the small amount of change of field size change is due only to change within farms. Figure 5.8 shows the changes in field size in the sample area. In the first three categories, there was a reduction of field numbers, but in the other three categories there were increases in numbers of fields. A point to be noted is the change in the total area of fields in the sample area. The total area has increased slightly in all parishes, and some additional land has been improved for agricultural purposes. The greatest rate of increase has been in Prestonkirk, where 119 ha was added to the agricultural land (a 6.55% change). The increase in the area in other parishes was 10.7 ha (Athelstaneford); 28.9 ha (Haddington) and 6.2 ha (Morham). The small change in field size in Morham is related to the total area of agricultural land proportionate to other parishes. Table 5.8 and Figure 5.9 represent the patterns of field size change. Fields are categorised at 5 hectares intervals so that change in field size can be evaluated more clearly. The figure presents the patterns of change in field size in parishes from 1972 to 1988. Figure 5.9 shows the average field size change in the area. Average field size has increased through field amalgamation. In Haddington, it increased from 9.92 ha to 11.7 ha, an increase of about 17%. The same results obtain for Athelstaneford and Prestonkirk.

Table 5.8 shows the statistical summary of change in field size in the sample parishes. In Morham fields less than 15 ha have a decreased, with a total reduction of 6 fields, but three new fields have emerged in 15 to 30 ha size range. In Haddington, a reduction has occurred for fields of up to 15 ha, with a total decrease of 53 fields. In Haddington, the highest change (an increase of 9 fields), occurred in the category 14.9 to 20 ha. Some new fields of above 40 ha have been created. The highest change has appeared in Athelstaneford for fields of up to 25 ha, with a total reduction of 26

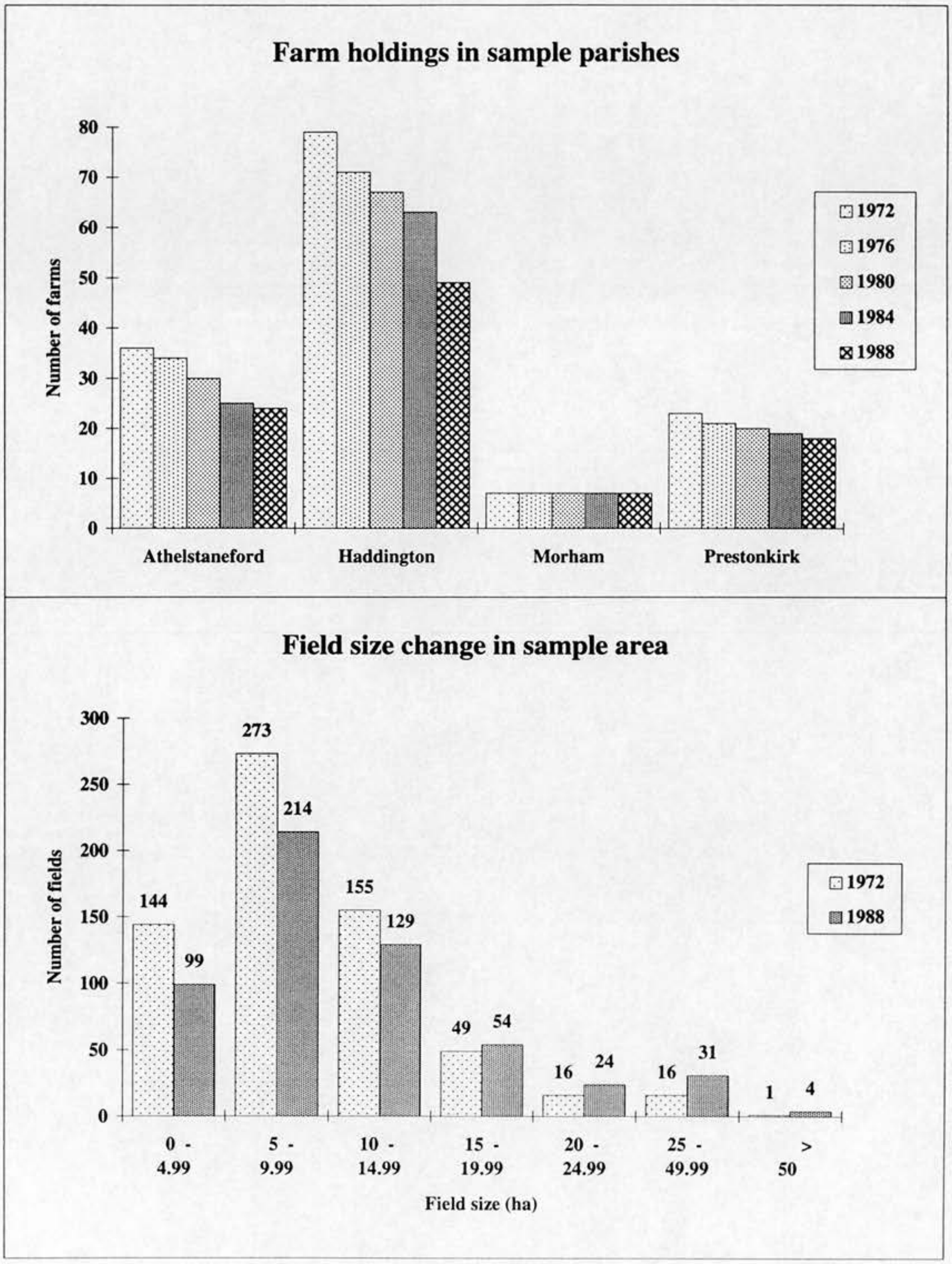


Figure 5.8 Changes in farm holdings and field size in sample parishes

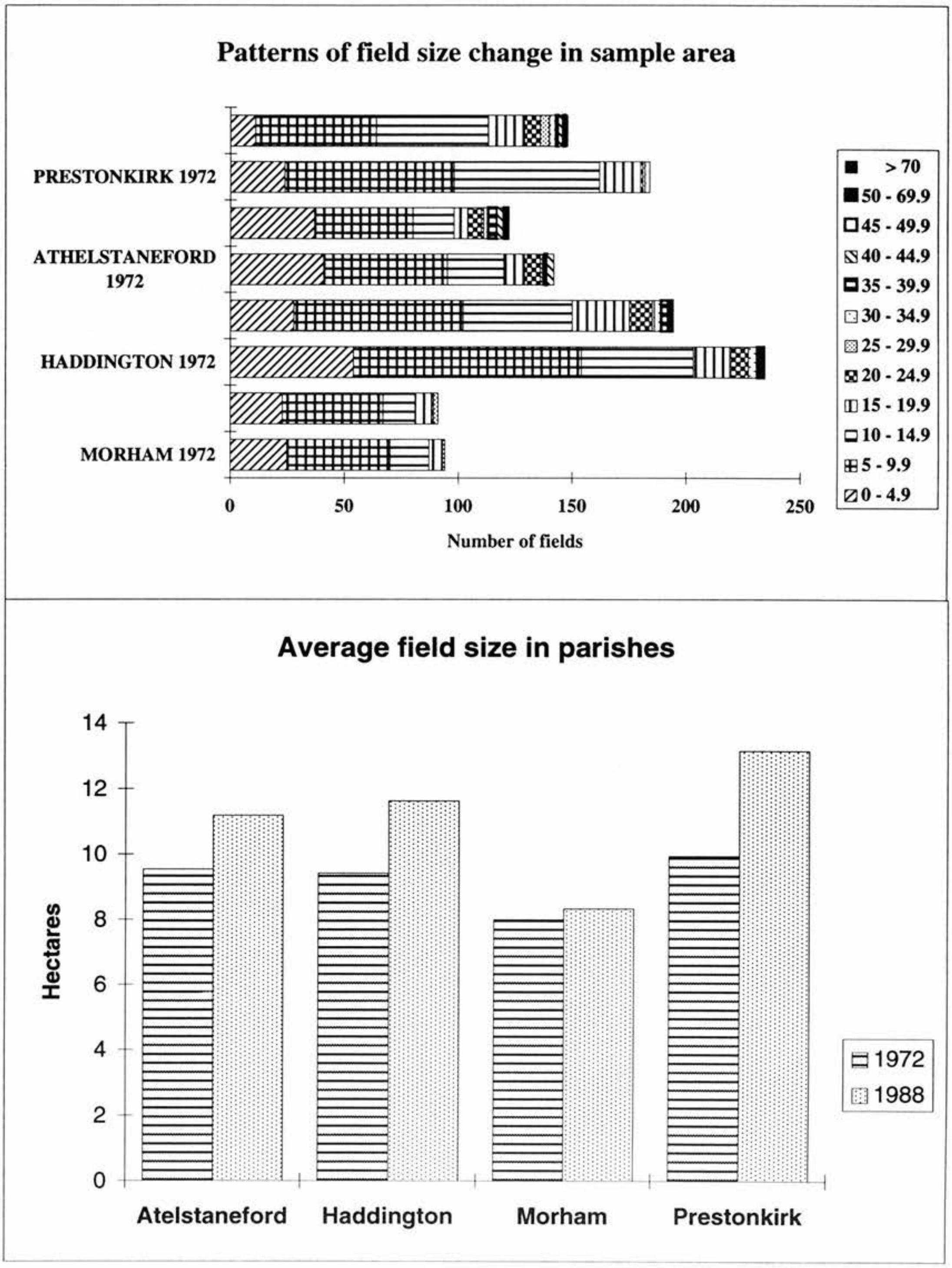


Figure 5.9 Patterns of field size change in sample parishes

fields. This reduction has resulted in an increase of six large fields up to 70 ha in size. In Prestonkirk 51 fields up to 20 ha of field size have disappeared, but 15 new fields of up to more than 100 ha have appeared.

Table 5.8 Patterns of field size in sample parishes

	Morham		Haddington		Athelstaneford		Prestonkirk	
Hectares	1972	1988	1972	1988	1972	1988	1972	1988
0 - 4.9	25	23	54	28	41	37	24	11
5 - 9.9	45	44	100	74	54	43	74	53
10 - 14.9	17	14	49	48	25	18	64	49
15 - 19.9	6	7	16	25	9	6	18	16
20 - 24.9	0	1	8	10	7	6	1	7
25 - 29.9	1	2	0	1	1	1	1	4
30 - 34.9			4	3	1	2	2	3
35 - 39.9			1	3	1	4	0	1
40 - 44.9			1	1	3	3	0	2
45 - 49.9			0	0	0	1	0	0
50 - 69.9			1	1	0	1	0	1
>= 70			0	0	0	0	0	1
Total change	**94**	**91**	**234**	**194**	**142**	**122**	**184**	**148**

Source: Rural landscape change data

The pattern of changes in field sizes can be seen in Figure. 5.10. In all parishes, the highest change is for fields of less than 10 hectares. These small fields have been amalgamated to enlarge the fields. Morham is the exception with no field greater than 30 hectares. On the other hand, Prestonkirk has the largest field, one field being more than 100 ha in 1988, a result of field amalgamation. Another point to be noted is that the total area of the fields has also increased slightly, the result of some additional land being converted to arable. Again, the highest change in total area is in Prestonkirk (+6.55%).

The questionnaire survey covered 28 farms in these four parishes, of which 18 farms are arable. Data extracted from the questionnaire survey show a high level of field amalgamation in the area. For instance, in Athelstaneford five farms out of six amalgamated their fields. Five farms have increased their area and two farms decreased their area. Haddington and Prestonkirk show a very high level of field amalgamation. In Haddington eight out of nine and in Prestonkirk six out of eight farms have amalgamated their fields.

Figure 5.10 Spatial patterns of field size change in sample area

5.4.2 Field Boundaries

Table 5.9 shows the pattern of field boundaries in the sample area.

Table 5.9 Field boundaries in sample area (kilometres)

	1972	1988	Removed	Added	change 72-88	% change
Hedgerows	250.13	287.74	16.80	54.42	37.61	15.04
Post & wire fences	346.62	286.13	63.26	0.43	-60.50	-17.45
Vegetative belt	162.39	170.35	3.25	11.17	7.96	4.90
Tree line	135.28	132.42	12.24	19.20	-2.85	-2.11
Stone wall	143.90	134.92	8.98	0.00	-8.98	-6.24
Dykes & others	142.85	131.93	12.93	1.93	-10.92	-7.64
Total	**1181.16**	**1143.49**	**117.46**	**87.15**	**-37.67**	**-3.18**

Source: Rural landscape change data

The total length of 1181.16 km in 1972 has reduced to 1143.49 km in 1988, a decrease of about 38 km of length. The highest decrease of length has appeared under the post & wire fence field boundary, which has reduced from 346.62 km to 286.13 km (a decrease of 60 km). The highest increase has occurred in the hedgerows as a field boundary, which has increased from 250.13 km to 287.74 km (an increase of about 38 km). These patterns may be seen in Table 5.10. There has, for example, been addition and removal of field boundaries. For example, a total length of 16.80 km of hedgerows has been removed, but 54.42 km of hedgerows has been added. The tree-line boundary type has the second highest rate of addition after hedgerows with a length of 19.20 kms. This boundary type also had 12.24 kms of removal in this period. The lowest addition was of post & wire fences which had only a 0.43 km increase. Stone walls had no additions. Figure 5.11a presents the percentage changes in field boundaries. The post & wire boundary type, which accounted for 29.35% of total length of all boundaries in 1972, was reduced to 25% in 1988 (a decrease of 4.35%). Hedgerows, which constituted 21.19% of all boundaries, rose to 25.16% (an increase of about 4%). Other type of boundaries have only slight changes in their proportions.

Table 5.10 shows the length of field boundaries per ha of land under analysis.

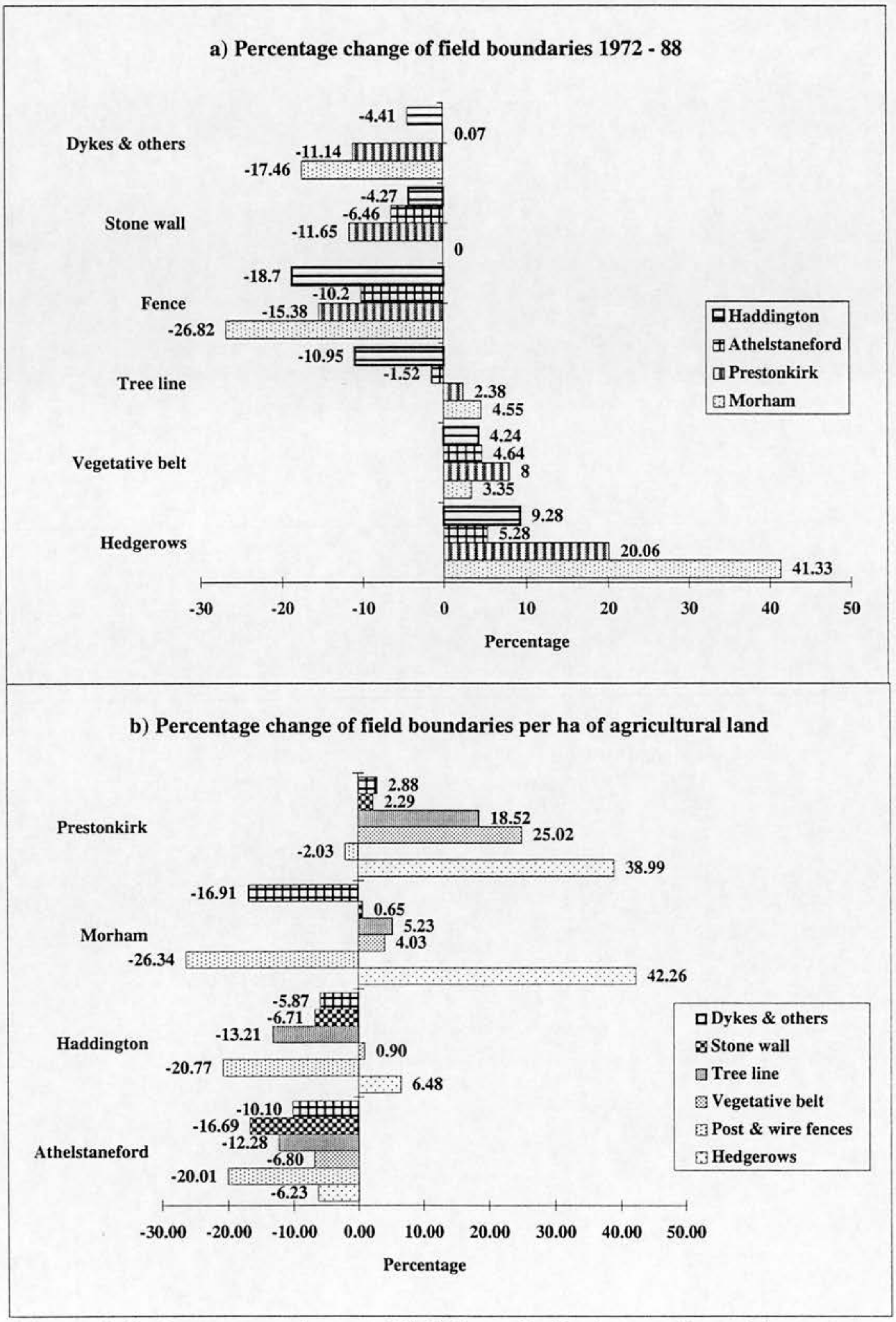


Figure 5.11 Percentage change of field boundaries in sample parishes

Table 5.10 Patterns of field boundaries in sample area (metres per ha)

	1972	1988	change 72-88	% change	Area in 1972	Area in 1988
Hedgerows	40.8	45.7	4.9	12.0	6136.6	6302.0
Vegetative belt	26.5	27.0	0.6	2.2	6136.6	6302.0
Tree line	22.0	21.0	-1.0	-4.7	6136.6	6302.0
Post & wire fences	56.5	45.4	-11.1	-19.6	6136.6	6302.0
Stone wall	23.4	21.4	-2.0	-8.7	6136.6	6302.0
Dykes & others	23.3	20.9	-2.3	-10.1	6136.6	6302.0

Source: Rural landscape change data

Figure 5.12 shows the patterns of change field boundaries within the total length of these boundaries. Figure 5.13 describes the overall comparative change of field boundaries from 1972 to 1988 for the sample parishes. There has been an increase in vegetative boundaries and decrease in non-vegetative boundaries, although there are variations among parishes. Table 5.11 presents the percentage changes in field boundaries during the period 1972 and 1988. The parish of greatest change is Morham which had substantial re-planting of hedgerows (about 41% net increase) and removal of fences (27%). A major loss in Morham was the removal of dykes and other boundary types (18 %). Another parish with great losses is Haddington, where hedgerows have replaced the post & wire type of boundary. Prestonkirk has the same pattern with a loss in post & wire fences and a gain in hedgerows. This parish has the lowest levels of gain and loss of different boundaries. Figure 5.16 illustrates how hedgerows have been planted at the expense of post & wire fences. There has also been removal of hedgerows in order to enlarge the

Table 5.11 Percentage change of field boundaries in parishes (1972 - 88)

	Athelstaneford	Haddington	Morham	Prestonkirk
Hedgerows	5.28	9.28	41.33	20.06
Vegetative belt	4.64	4.24	3.35	8
Tree line	-1.52	-10.95	4.55	2.38
Post & wire fences	-10.2	-18.7	-26.82	-15.38
Stone wall	-6.46	-4.27	0	-11.65
Dykes & others	0.07	-4.41	-17.46	-11.14

Source: Rural landscape change data

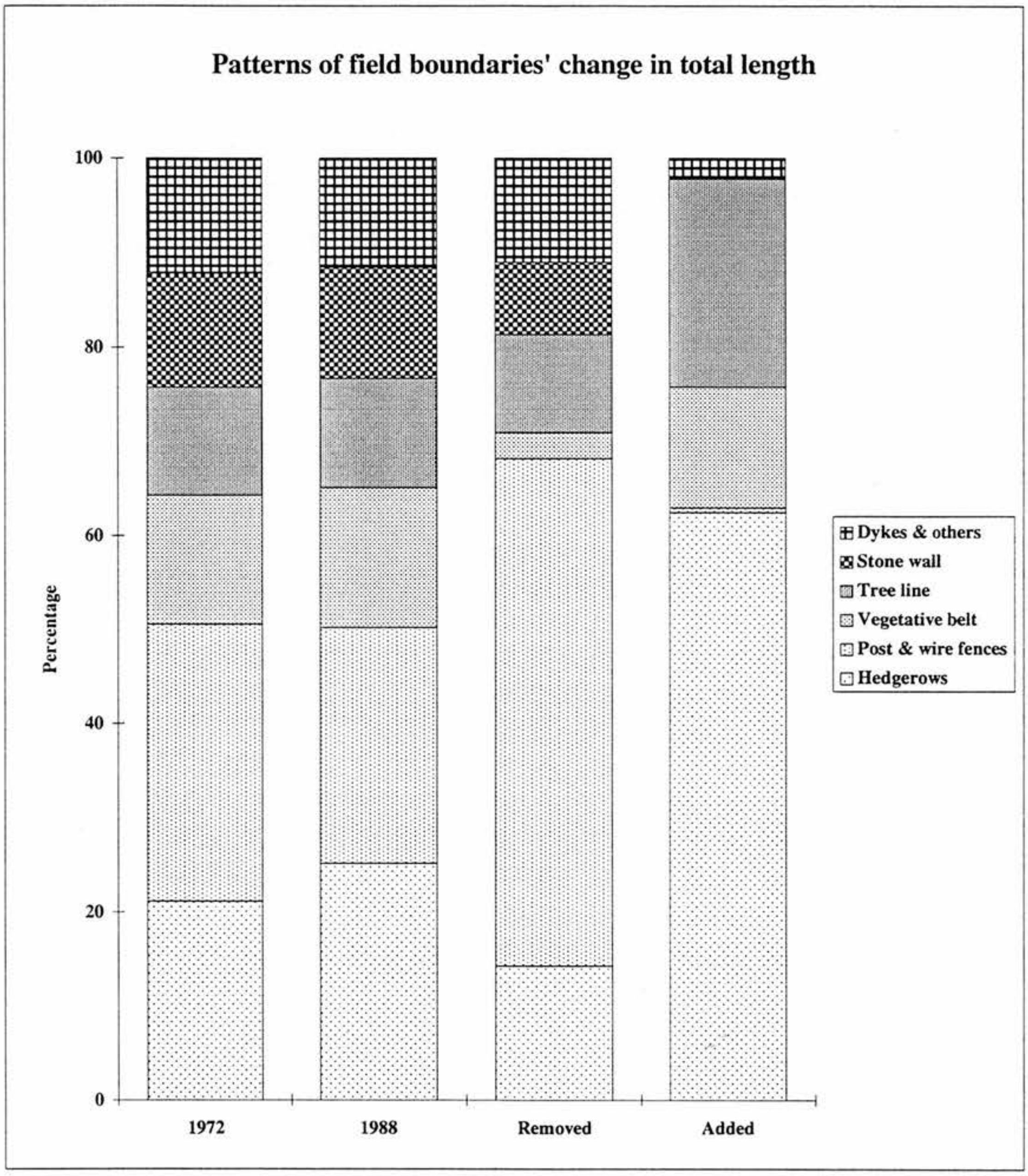
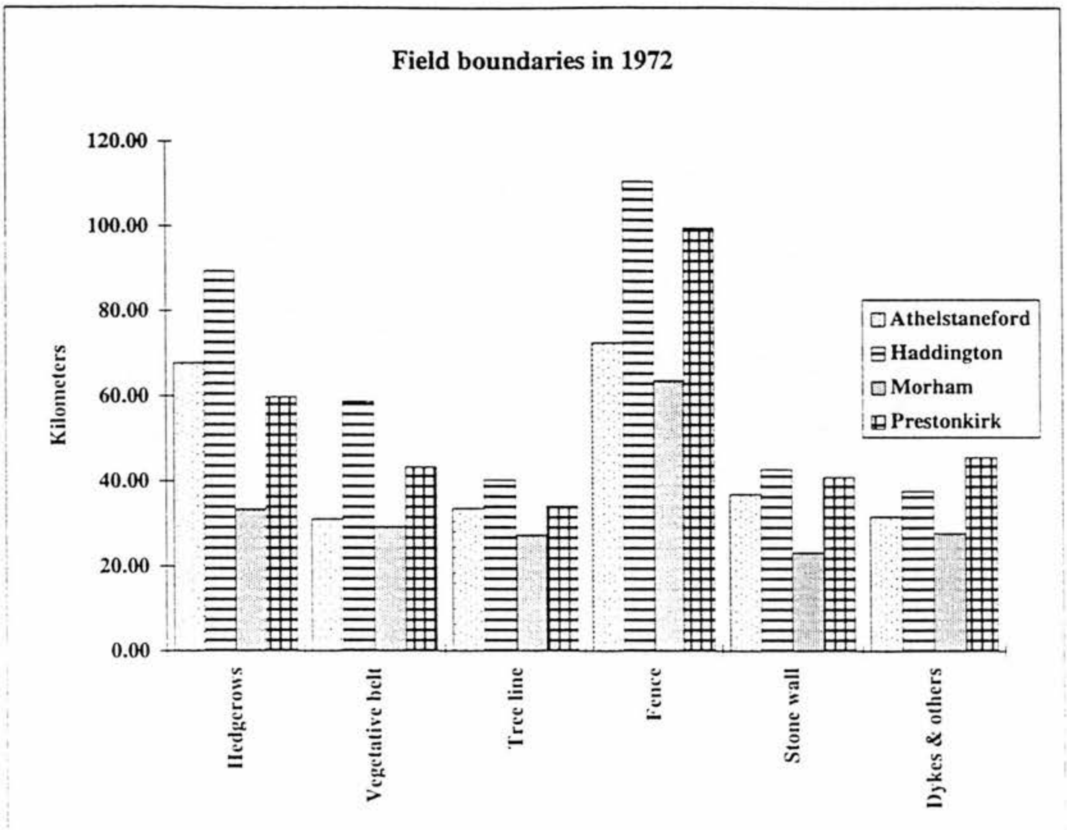


Figure 5.12 Patterns of field boundaries change in total length in sample area



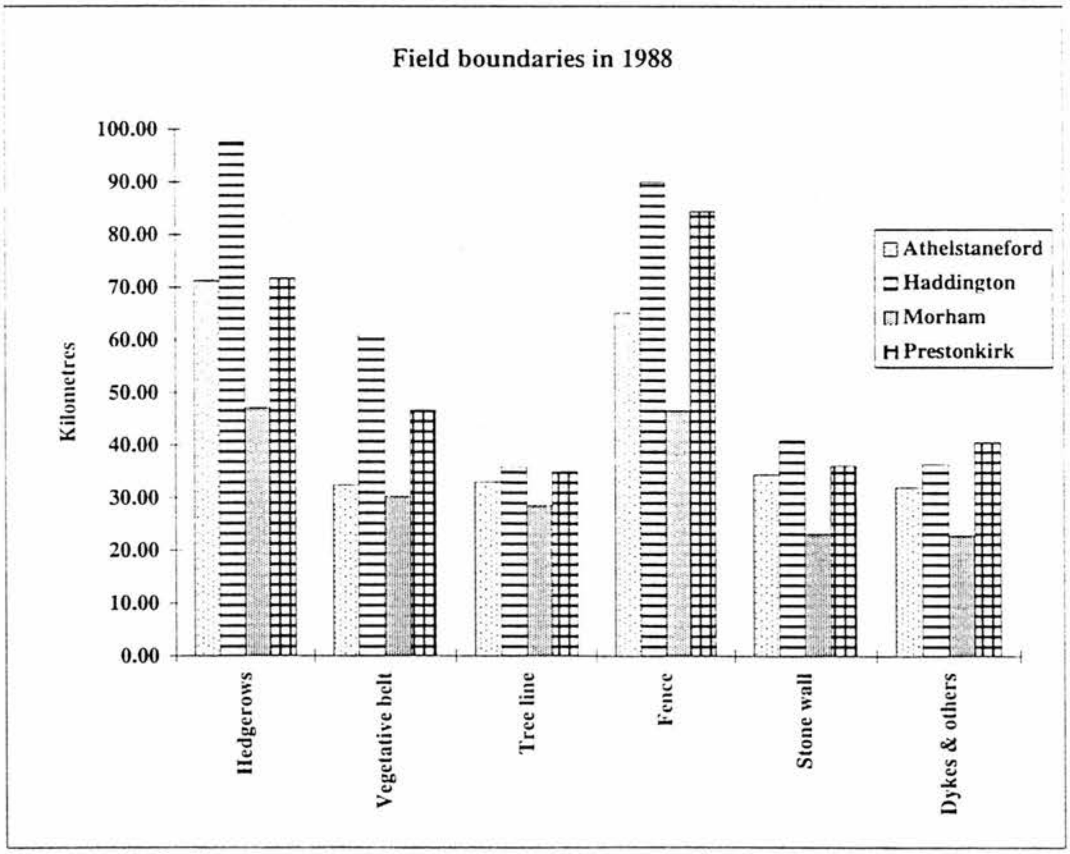


Figure 5.13 Comparative change in field boundaries between 1972 and 1988

fields. The capital grant schemes have encouraged farmers to replant hedgerows by offering grants in order to enhance the natural beauty of the landscape. As a result, several farmers have re-planted hedgerows and trees and other types of vegetative field boundary. This process has led to the re-placement of post & wire fences, not least since they are relatively convenient to remove.

Table 5.12 gives the annual rate of percentage change in field boundaries. It shows, too, that the rate of loss has been greater than the rate of increase in the vegetative type of boundaries. The rate of increase of hedgerows in Haddington and Morham is 2.58% and 1.25% per annum respectively. The highest rate of loss for fence and dykes & others is in Morham. There were no changes to stone wall boundaries in this parish.

Table 5.12 Percentage change of field boundaries per annum (1972 - 88)

	Athelstaneford	Haddington	Morham	Prestonkirk
Hedgerows	0.33	0.58	2.58	1.25
Vegetative belt	0.29	0.27	0.21	0.50
Tree line	-0.10	-0.68	0.28	0.15
Post & wire fences	-0.64	-1.17	-1.68	-0.96
Stone wall	-0.40	-0.27	0.00	-0.73
Dykes & others	0.00	-0.28	-1.09	-0.70

Source: Rural landscape change data

Table 5.13 shows the relationship between field boundaries and the agricultural land for the sample parishes. The change in the total length of field boundaries show different patterns of change because of change in the area under agricultural land (length per ha) and shows the relationship between field boundaries and agricultural land.

Table 5.13 Patterns of field boundaries in sample area

(metres per ha of agricultural land)

	1972	1988	change 1972-88	% change	Agricultural land 1972	Agricultural land 1988
Hedgerows	28.99	33.51	4.52	15.59	8628.2	8586.8
Post & wire fences	40.17	33.32	-6.85	-17.06	8628.2	8586.8
Vegetative belt	18.82	19.84	1.02	5.41	8628.2	8586.8
Tree line	15.68	15.42	-0.26	-1.64	8628.2	8586.8
Stone wall	16.68	15.71	-0.97	-5.79	8628.2	8586.8
Dykes & others	16.56	15.36	-1.19	-7.20	8628.2	8586.8

Source: Rural landscape change data

In 1972, the lengths of field boundaries per ha of agricultural land were 40.7m (hedgerows); 56.5m (post & wire fences) 26.5m (vegetative belt); 22m (tree line); 23.4m (stone walls) and 23.3m (dykes & others). Equivalent lengths in 1988 were 45.6m; 25.4m; 27m; 21m and 21m respectively. Again, the highest reduction was in post & wire fences and the highest increase was in hedgerows. Figure 5.11b shows the relationship between field boundaries and the agricultural land for the sample parishes. There are great variations between parishes; for instance, in hedgerows in Prestonkirk which had a 39 percent increase or nearly double that shown in Figure 5.11a. In Athelstaneford, there was a loss of hedgerows due to an increase in the area under agricultural land between 1972 and 1988. The same results also obtain for other parishes. Athelstaneford has another exception in that all types of field boundaries have diminished. This means that under agricultural intensification and an increase in the total area of crops and grass, the total length of field boundaries has tended to decrease. Prestonkirk has a 2.03% decrease in post & wire fences and a 15.38% decrease in the total length of this boundary.

Table 5.14 shows the percentage change in the length of hedgerows between 1972 and 1988, and Figures 5.14 and 5.16 present the patterns of change in hedgerows.

Table 5.14 Patterns of hedgerows (km)

	1972	1988	change 1972-88	Removed	Added	% change
Athelstaneford	67.67	71.24	3.57	7.09	10.66	5.28
Haddington	89.38	97.66	8.28	3.03	11.31	9.26
Morham	33.33	47.10	13.78	2.27	16.05	41.34
Prestonkirk	59.75	71.74	11.99	4.41	16.40	20.06

Source: Rural landscape change data

It clearly shows an overall gain in hedgerows, a development contrary to long-term trends. The highest increase for the given period is in Morham with a 41 % increase in total length. The increases in the other parishes are 20%, 10% and 5% for Prestonkirk, Haddington and Athelstaneford respectively. Figure 5.14 shows the distribution of the removal and re-planting of hedgerows. It can be seen that there have been a number of losses and gains of hedgerows within the same parish.

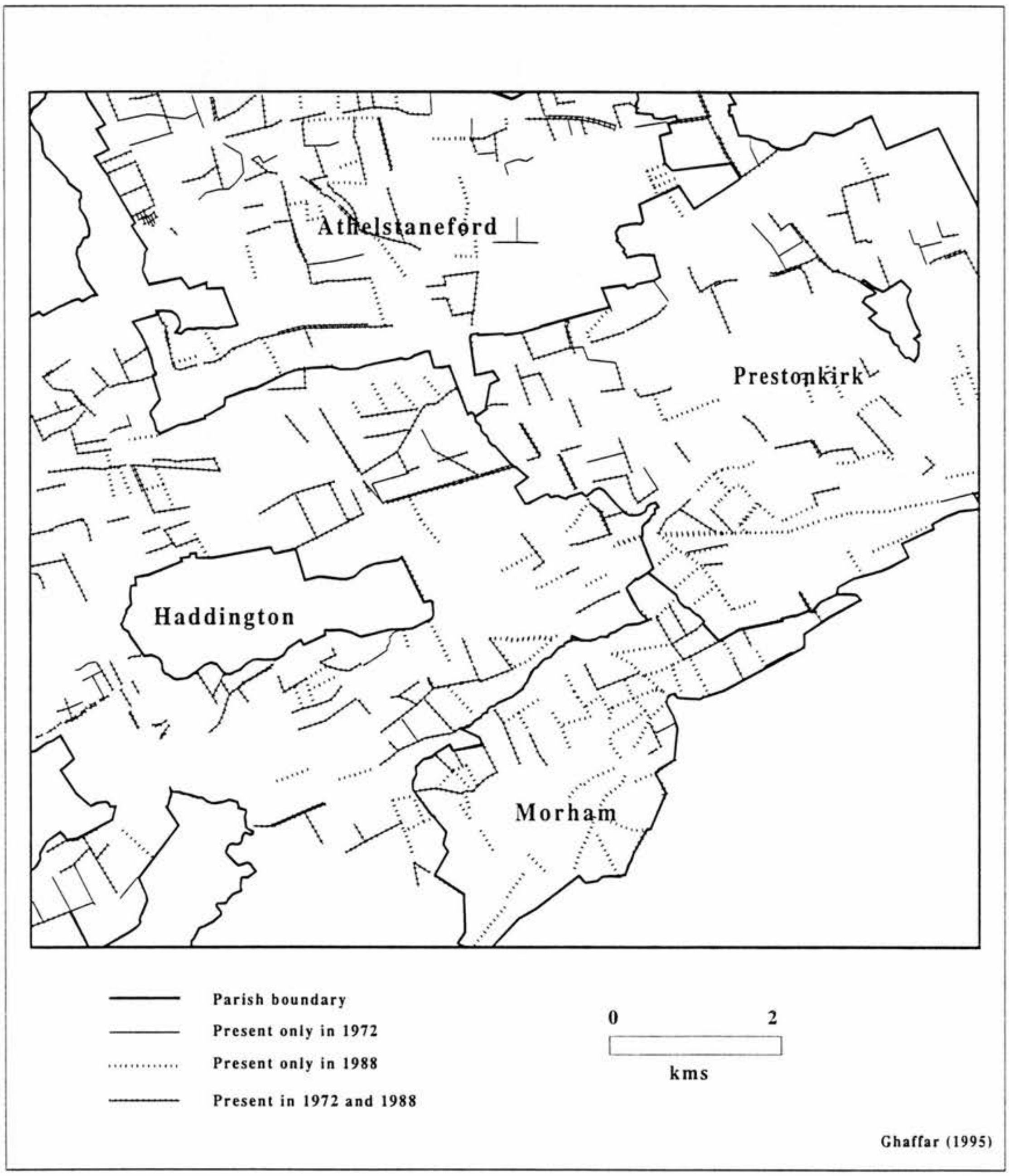


Figure 5.14 Spatial patterns of hedgerows as field boundary

Hedgerows have been removed in order either to enlarge the field size under farm amalgamation schemes or to intensify agricultural production. The re-appearance of hedgerows can be linked to the schemes offered by the government and under the CAP's influence in providing money in order to encourage farmers to re-plant hedgerows. This re-planting has been done at the expense of other field boundaries, especially post and wire fences. Table 5.12 shows the annual percentage change of hedgerows for the four parishes and illustrates well the average increase in total length of hedgerow during the period. The highest increase per annum is 2.58% for Morham and the lowest increase, 0.33%, for Athelstaneford. If we examine the pattern of removal of hedgerows for Athelstaneford, the evidence clearly illustrates the location of removal through the enlargement of fields and how re-planting is occurring on other boundaries and along roads. Hedgerows have been re-planted at more than 20 locations throughout the parish. The pattern of hedgerows in Haddington shows great removal of hedgerows as well as re-planting. Hedgerows have been removed from more than 15 locations, but also re-planted at more than 30 locations widely dispersed in the parish. A total length of 3.04 km has been removed, but 14.04 km has been re-planted. For Morham 2.29 km has been removed and 16.29 km re-planted in spite of its small size. There has been only a few removals, but there has been re-planting at more than 40 places, especially at the expense of post & wire fences. This parish has the smallest extent of field enlargement, but the highest rate of change of field boundaries and replanting of hedgerows. Some hedgerow removal has occurred along roads and replanting is widespread. Nearly all farms have replaced post and wire fences and other boundaries with hedgerows. In Athelstaneford 7.09 km of hedgerow has been removed and 10.06 km replanted. Hedgerows have been removed from 20 places, and re-planted at 25 locations. Re-planting has occurred chiefly in the southern part of the parish, whilst removal has a dispersed pattern. The same results are present in Prestonkirk where a total length of 4.42 kms has been removed and 16.33 kms has been replanted.

Post & wire field boundaries have the highest percentage of removal in all parishes. This field boundary has been removed for the enlargement of fields and has been replaced by new hedgerows. The removal of this boundary and its enlargement by hedgerows reflects the requirements of less time and labour compared with the removal of other types of boundaries, and also reflects adoption of incentives under the capital grant schemes.

Table 5.15 presents the percentage change in this boundary type.

Table 5.15 Patterns of post & wire fences (km)

	1972	1988	change 1972-88	Removed	Added	% change
Athelstaneford	72.50	65.11	-7.39	7.82	0.43	-10.2
Haddington	110.62	89.94	-20.68	20.68	0	-18.7
Morham	63.72	46.64	-17.09	17.09	0	-26.78
Prestonkirk	99.78	84.44	-15.34	15.34	0	-15.38

Source: Rural landscape change data

Figure 5.15 represents the patterns of removal and presence of post and wire fences. The pattern of removal of this boundary is widely dispersed. In Athelstaneford, there are 25 places where this boundary has been removed with a total loss of 7.82 kms and only three places where this boundary has been erected, with an increase of 0.43 km. In Haddington the changes are spread widely throughout the parish. Removal has occurred at more than 50 places with a total length of 20.68 kms, mostly replaced (in about 30 locations) by hedgerows. No new post & wire field boundaries have been erected in this parish. Prestonkirk has the same pattern with substantial removals all over the parish (about 40 places) with a total loss of 17.67 kms, most of which has been replaced by hedgerows. In spite of its small size, Morham has over 50 locations at which there has been removal of this boundary covering a total length of 17.09 kms. Figure 5.16 shows how this boundary has been removed at the expense of hedgerows.

Vegetative field boundaries include woodland fringes, any type of vegetative belt except hedgerows and semi-natural vegetative belts along fields and rivers. Table 5.16 gives the comparative changes in these field boundaries in the sample parishes.

There are patterns of removal and re-plantation of this boundary in the sample parishes. There has been no removal of this boundary in Athelstaneford but there has

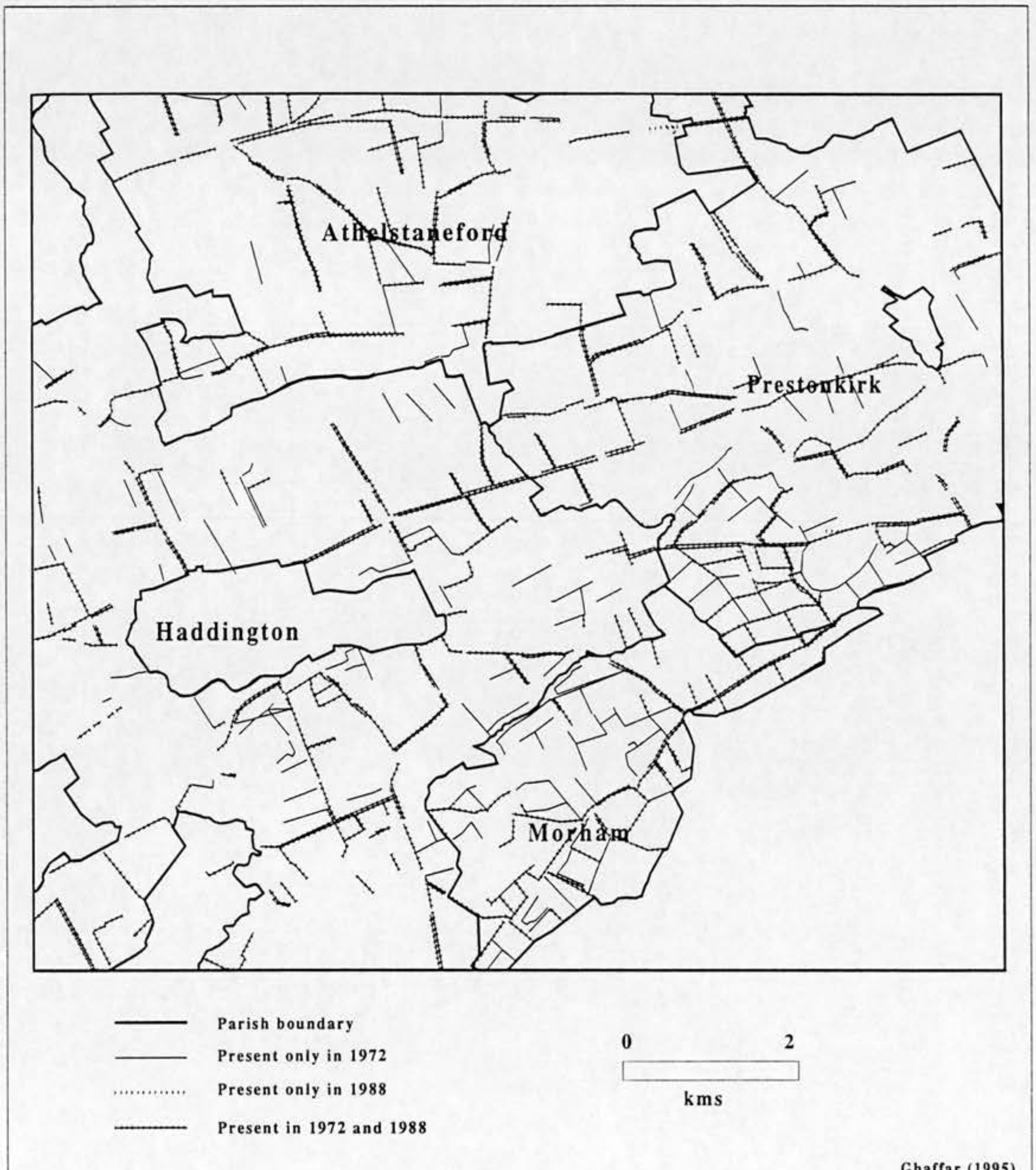


Figure 5.15 Spatial patterns of post & wire fences field boundary

Table 5.16 Patterns of vegetative belt (km)

	1972	1988	change 1972-88	Removed	Added	% change
Athelstaneford	30.99	32.43	1.44	0	1.40	4.64
Haddington	58.78	60.86	2.08	0.54	2.62	4.24
Morham	29.31	30.29	0.98	1.65	2.63	3.35
Prestonkirk	43.31	46.77	3.46	1.06	4.52	8

Source: Rural landscape change data

been an increase of 1.40 km. In Haddington 0.54 km has been removed at a few places, and there have been 2.62 km of new boundary appearing at about 8 places. In Morham there has been 1.65 km removed and 2.63 km of new boundary which means there is a decrease in this parish. As the total area of crops and grass has changed, the total length has also changed. This type of field boundary has some decrease only in Morham due to the removal of two vegetative belts (Figure 5.17). The highest increase of vegetative field boundaries was in Prestonkirk (8%). In Prestonkirk 1.06 km of this boundary has been removed but the new boundary has a total length of 4.52 km appearing at about 7 locations.

The tree-line boundary type has gains and losses amongst the four parishes. The total length of this boundary was 135.28 km in 1972. This length was reduced to 132.42 kms in 1988. Table 5.18 shows the summary results for this boundary type.

Table 5.17 Patterns of tree line (km)

	1972	1988	change 1972-88	Removed	Added	% change
Athelstaneford	33.49	32.98	-0.51	1.85	2.36	-1.52
Haddington	40.24	35.84	-4.40	6.17	2.45	-10.95
Morham	27.35	28.59	1.24	1.51	2.75	4.55
Prestonkirk	34.20	35.01	0.81	2.71	3.52	2.38

Source: Rural landscape change data

The highest loss of this boundary is in Haddington with about 11% change (a decrease of 4.40 kms). Morham is the only parish which also has a high gain of this boundary type. The lowest change (-1.52%) is in Athelstaneford. The total length of new boundary is 2.36 km compared with 1.85 km removed. The spatial patterns of this boundary can be seen in Figure 5.18.

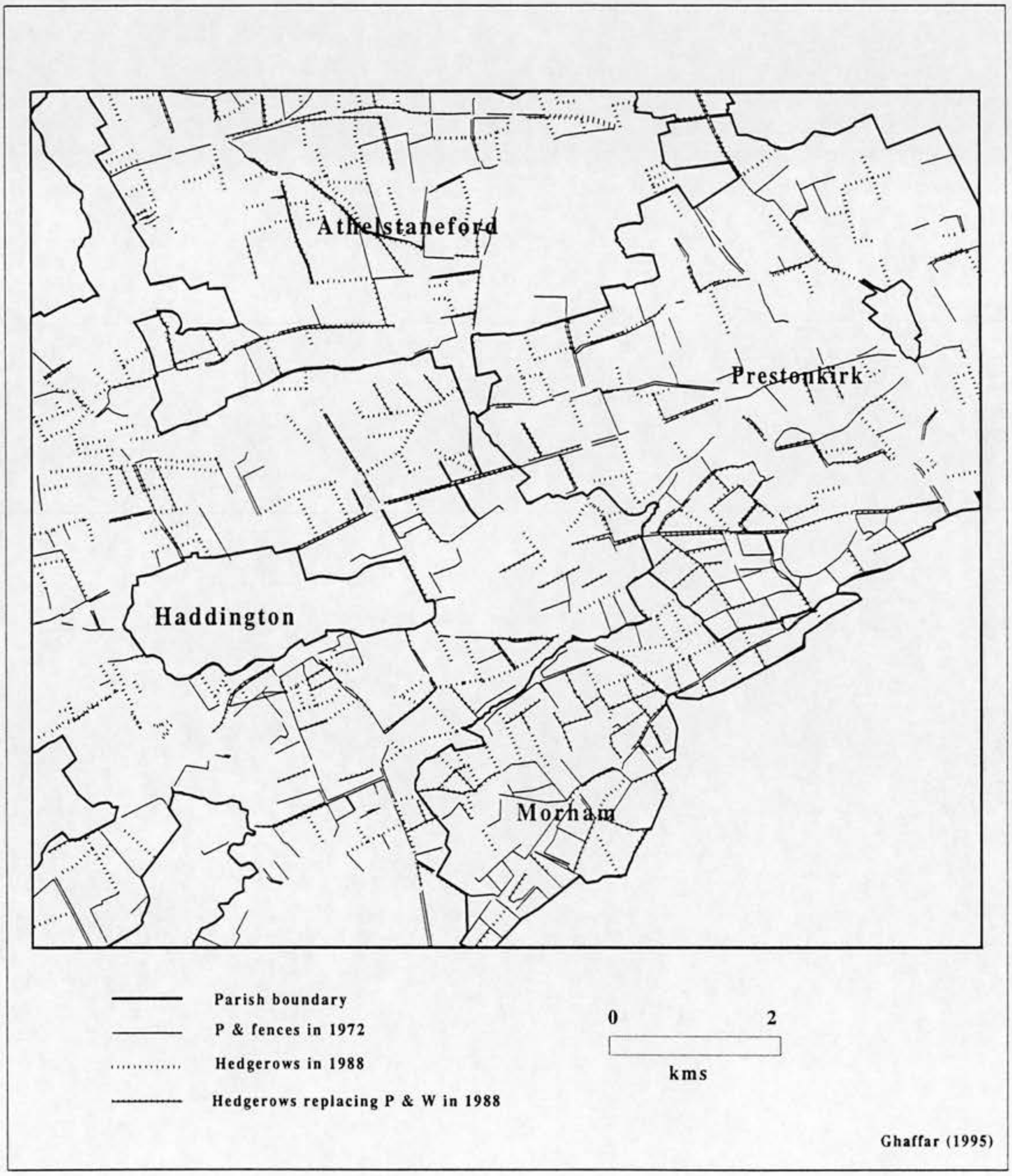


Figure 5.16 Spatial patterns of hedgerows replacing post & wire fences boundary

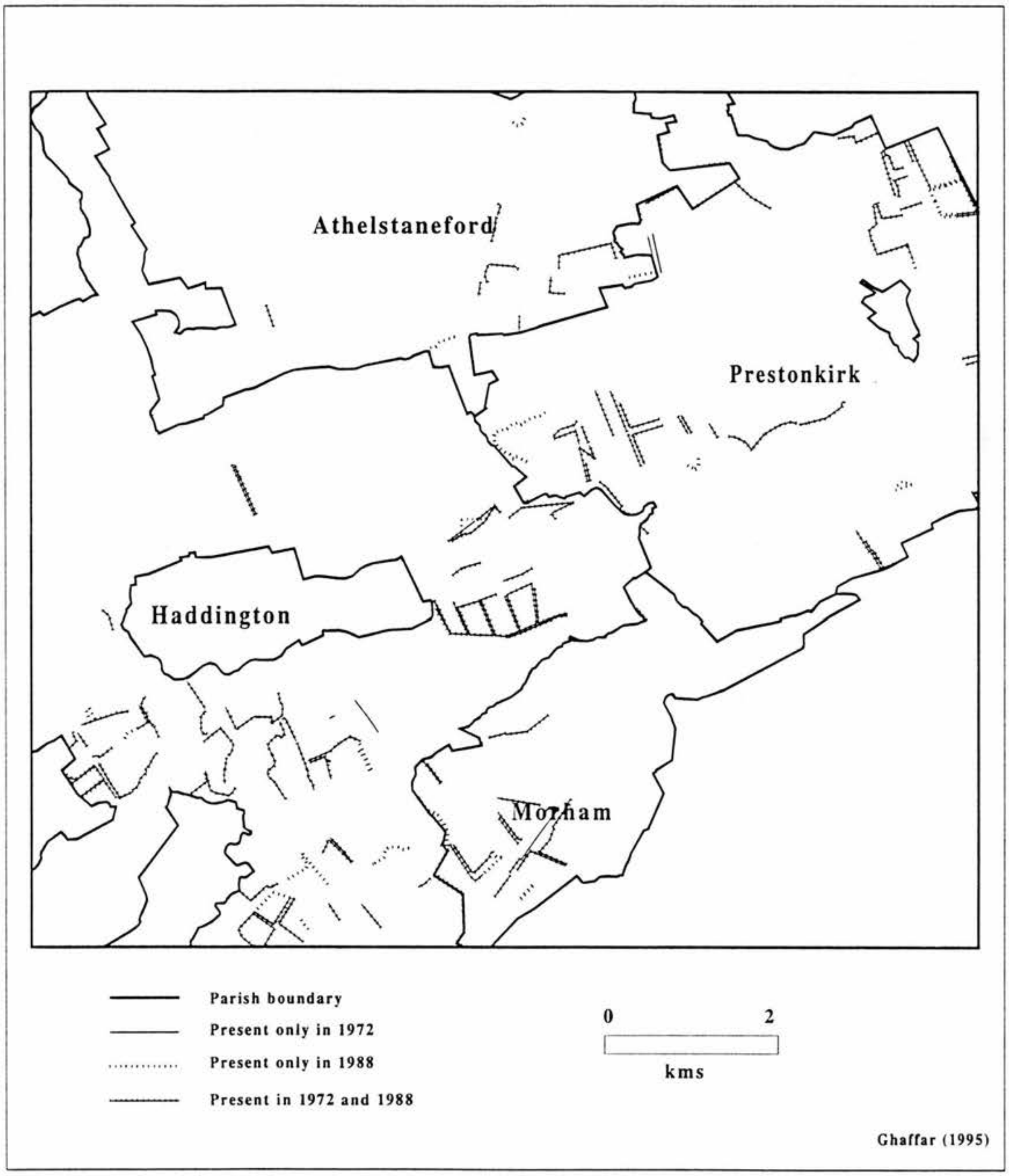


Figure 5.17 Spatial patterns of vegetative belt field boundary

Amongst the various types of field boundaries stone walls were an exceptional case. A net loss of this type of field boundary has occurred in all parishes except Morham where there has been no change. In no parish have new walls been erected. The highest removal of this field boundary has been in Prestonkirk with a total length of 4.77 kms. In Athelstaneford the total removal was 2.38 kms and in Haddington 1.83 kms. Figure 5.19 gives the spatial patterns of this field boundary. Table 5.18 lists the amount of change of this boundary in all parishes. This boundary has been removed for the amalgamation of fields but since its creation requires money and labour, farmers have greatly preferred to re-plant hedgerows.

Table 5.18 Patterns of stone wall (km)

	1972	1988	change 1972-88	Removed	Added	% change
Athelstaneford	36.87	34.49	-2.38	2.38	0	-6.46
Haddington	42.82	40.99	-1.83	1.83	0	-4.27
Morham	23.25	23.25	0.00	0	0	0
Prestonkirk	40.96	36.19	-4.77	4.77	0	-11.65

Source: Rural landscape change data

Dykes (ditches) and other types of field boundary have the highest rate of removal after post & wire fences. These boundaries have been removed for the amalgamation of fields and for re-planting of hedgerows. The extent of removal of these boundaries is 5.65 kms in Prestonkirk, 4.31 kms in Morham, 1.30 kms in Haddington and 1.16 kms in Athelstaneford. The only new additions were in Prestonkirk and Athelstaneford (0.84 km and 0.88 km respectively). The patterns of this boundary (Figure 5.20) show that this boundary has been removed not only to enlarge the fields but also to replant hedgerows. The greatest removal of this boundary for re-plantation of hedgerows is in Morham, which has the lowest field amalgamation among all four of the sample parishes in East Lothian.

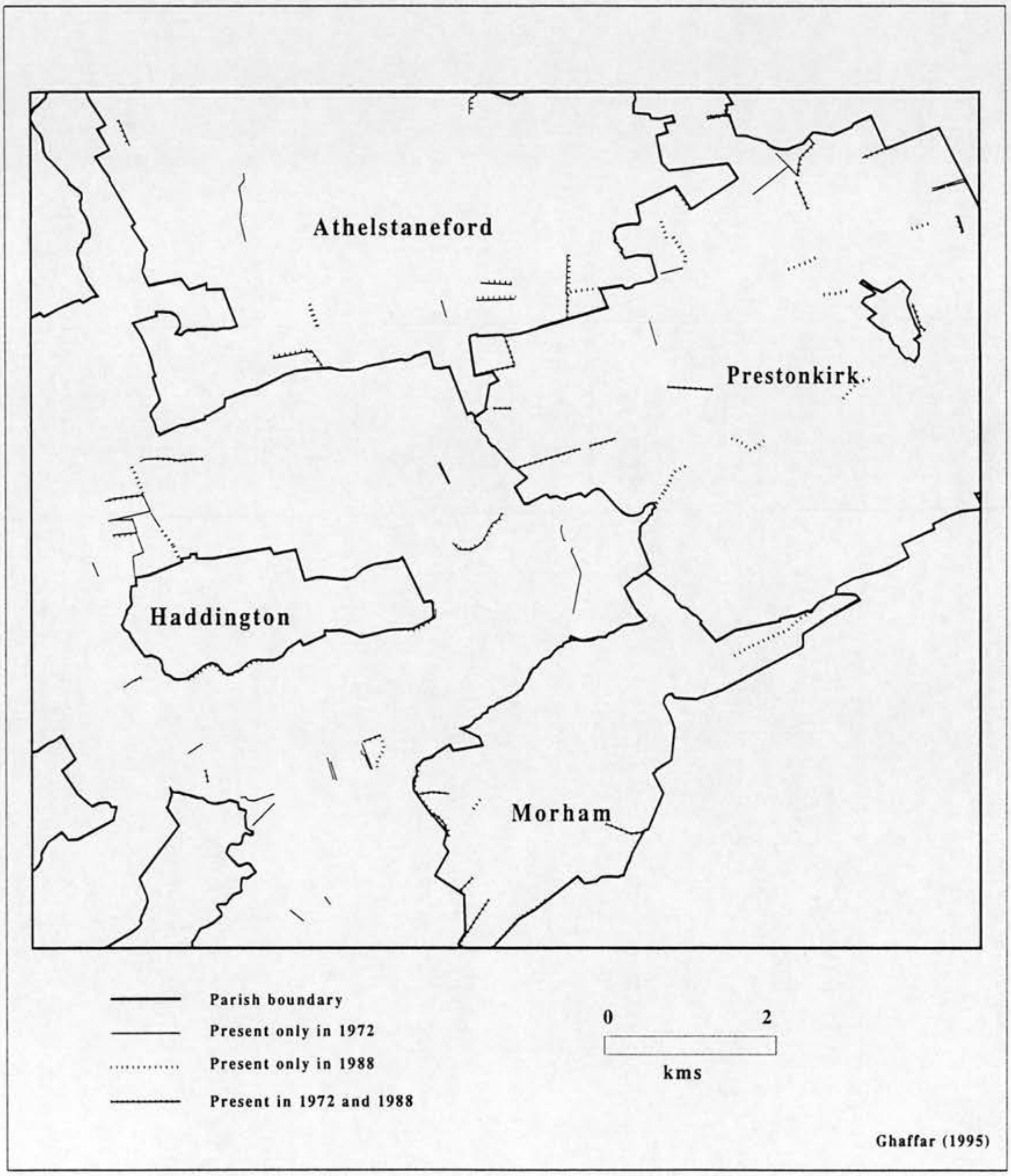


Figure 5.18 Spatial patterns of tree-line field boundary

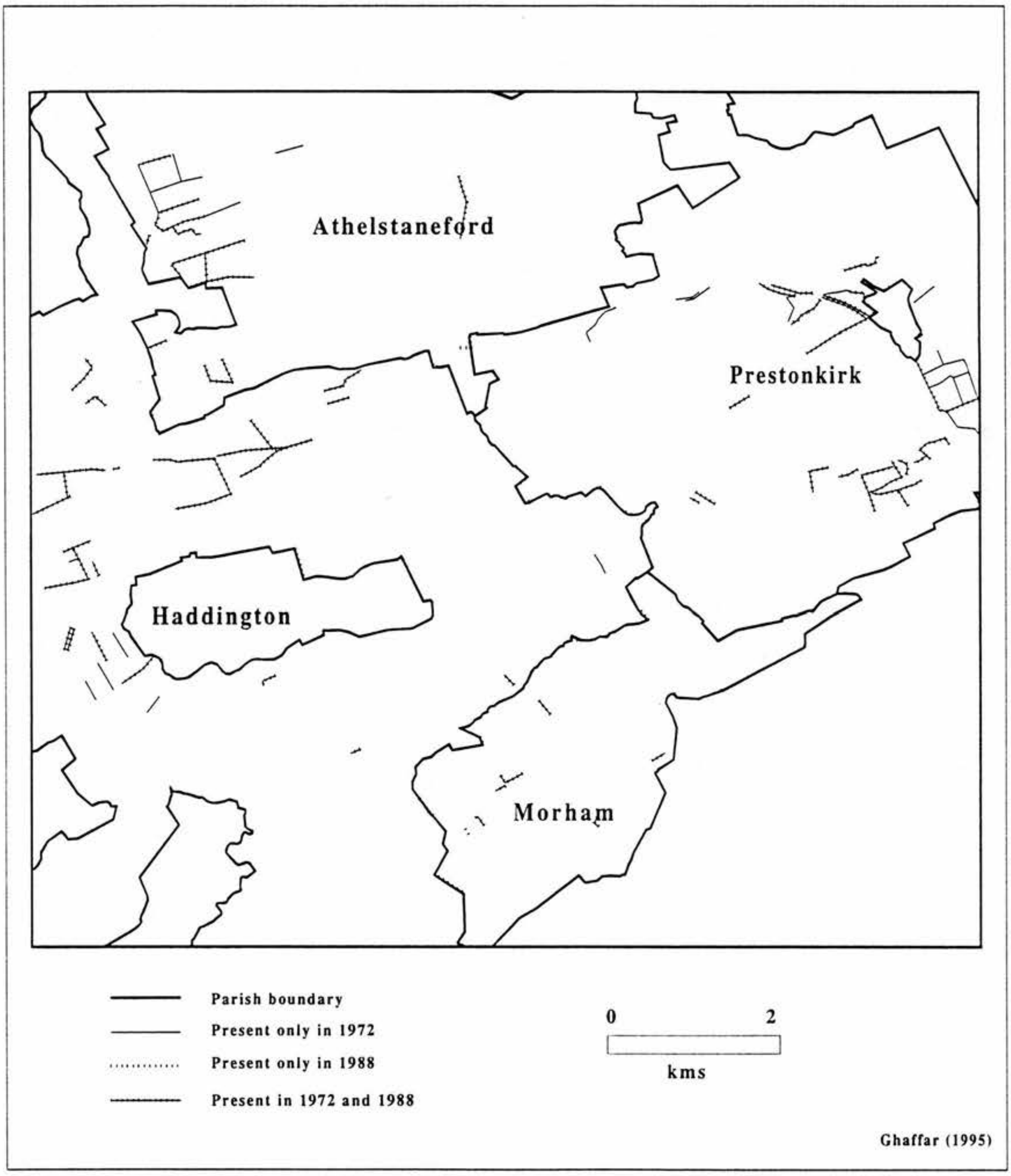


Figure 5.19 Spatial patterns of stone wall field boundary

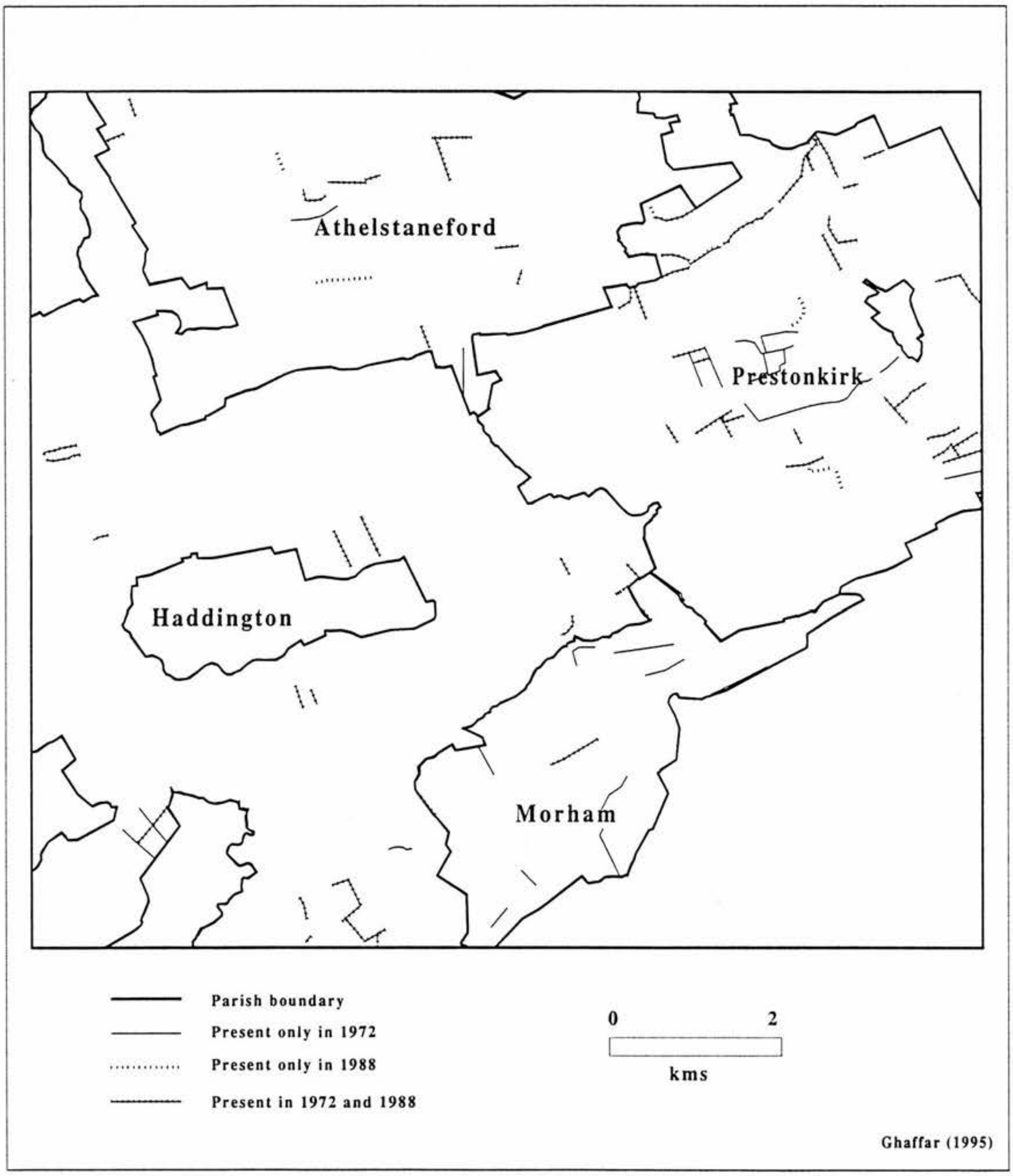


Figure 5.20 Spatial patterns of dykes and other field boundary

Table 5.19 lists in summary form the changing patterns of this boundary during this period.

Table 5.19 Patterns of dykes & others (km)

	1972	1988	change 1972-88	Removed	Added	% change
Athelstaneford	31.73	32.02	0.30	1.16	1.36	0.07
Haddington	37.71	36.42	-1.28	1.28	0	-4.41
Morham	27.75	22.90	-4.84	4.84	0	-17.46
Prestonkirk	45.66	40.58	-5.09	5.65	0.57	-11.14

Source: Rural landscape change data

Figure 5.21 shows the overall removal of field boundaries based on questionnaire survey data. The patterns of removal of field boundaries among various land use types is noteworthy. All removal of field boundaries is associated with arable or arable-type farming where farmers have removed field boundaries either for field amalgamation or for re-plantation of hedgerows. The boundary types most commonly removed are post & wire fences and hedgerows. Data derived from the questionnaire survey reveal that there has been little increase in area, yet there has been a removal of field boundaries. In Haddington six farms removed hedgerows and five farms removed post & wire fences. In Prestonkirk, four farms removed hedgerows and three farms removed post & wire fences. Morham has no change in farm holdings but it has a high rate of change of field boundaries and in enlarging of field size. For instance, three farms out of a total of six farms have amalgamated their fields and four farms have removed their field boundaries. The rate of the adoption of government schemes is also very high. For example, six out of seven in Athelstaneford; six out of nine in Haddington; three out of five in Morham and six out of eight in Prestonkirk have participated in the schemes offered by the government (e.g. FHDS, AHDS, FCGS). Removal of field boundaries in conjunction with non-arable fields has not been significant. This pattern of removals parallels exactly the findings of others, notably those by Newby (1988), Shoard (1980, 1987), Munton et al (1987), Countryside Commission (1984, 1987), Bowers and Cheshire (1983), Blunden (1985, 1988) and Blunden and Turner (1985) all of whom

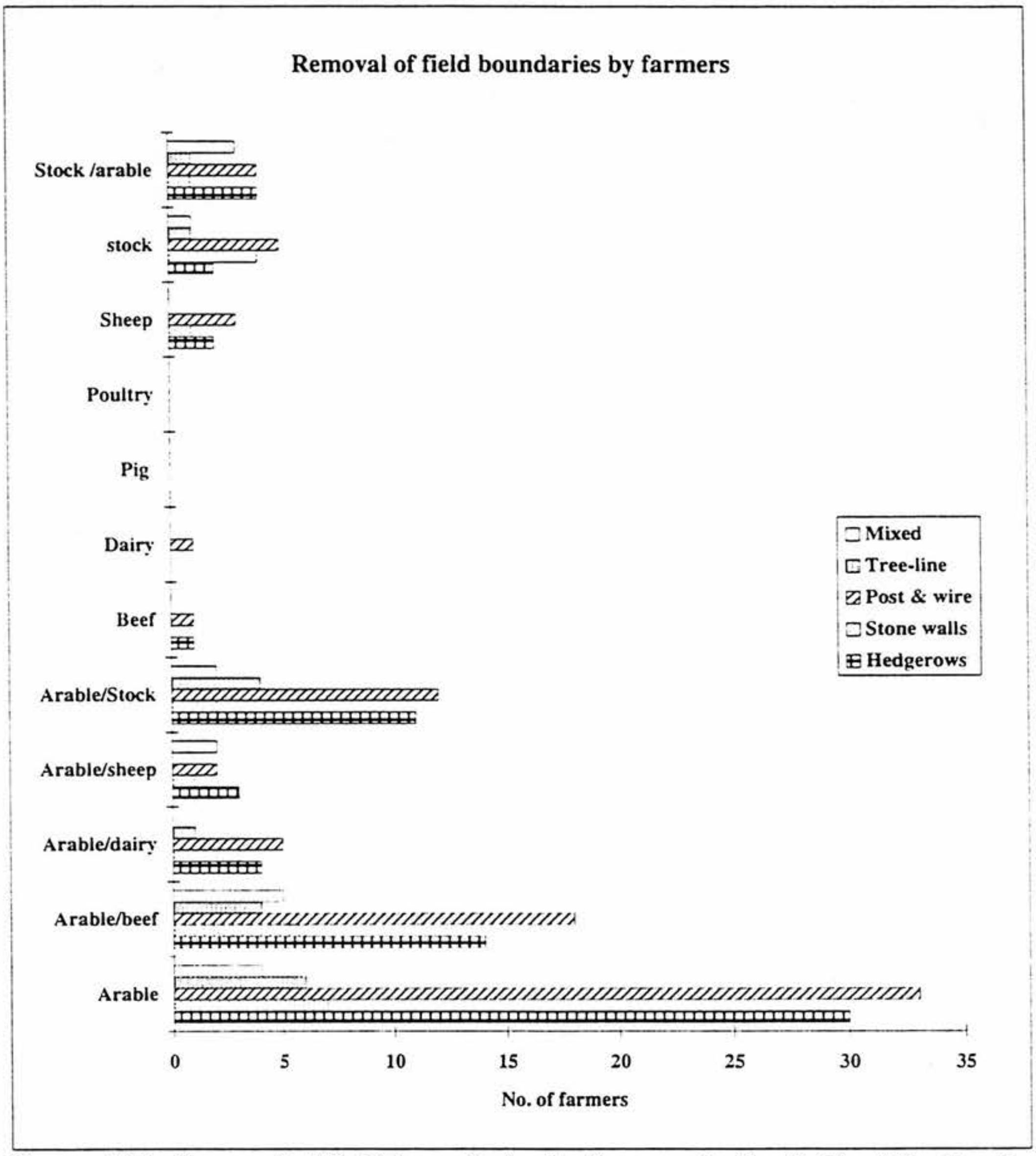


Figure 5.21 Removal of field boundaries by farmers in South East Scotland

recorded the removal of field boundaries, especially hedgerows, under the CAP-prompted intensification of agriculture.

The re-appearance of hedgerows can also be linked to schemes such as the Agricultural Improvement Scheme (National), (1985) which was offered by the government in order to encourage farmers to re-plant hedgerows and other farm features for the improvement of farm environment and landscape. Blunden and Curry (1988: 25) record that "In addition to general encouragements, the Agricultural Improvement Scheme was introduced in 1985 with specific help for conservation measures. Under this scheme for the first time, farmers and particularly medium sized farmers, may be eligible for grant aid for investment in environmental improvement measures and for pollution prevention measures, for planting hedges and shelter belts, building dry stone walls and for constructing footbridges and styles". The East Lothian sample parishes illustrate just how these changes have been evident in the period 1972 - 1988.

5.4.3 Woodland and Semi-Natural Vegetation

The total area of woodland in the sample area in 1972 was 432.9 ha which fell in 1988 to 429.1 ha. Woodland may be classified into three categories: coniferous woodland, non-coniferous woodland, and mixed woodland. The largest area of woodland is in Haddington, comprising mixed woodland with a total area of about 180 ha in both 1972 and 1988. The other two types of woodland have only a small share in the total area of woodland. Morham has the least area under woodland. Table 5.21 represents the patterns of woodland change in the sample area.

Table 5.20 Woodland change in East Lothian, 1972 - 1988 (ha)

	1972	1988	% change
Coniferous	71.8	89.2	24.2
Non conferous	63.3	61.8	-2.4
Mixed	297.8	278.1	-6.6
Semi-natural vegetation	118	86.5	-26.7

Source: Rural landscape change data

In spite of intensive arable farming, Haddington has the largest area under woodland amongst all parishes but almost all of this area is found in the southern part of the parish which is more than 200 metres amsl and which is less favoured for cereal cultivation. According to the Agricultural Returns for June 1972, the area under farm farm woodland was 63, 24, 9 and 51 hectares for Haddington, Morham, Athelstaneford and Prestonkirk respectively. By 1988, the area of farm woodland had increased in all parishes except Morham. The highest increase (of about +367%) was in Athelstaneford. The increase in Haddington was about 33%, in Prestonkirk about 12%. In 1972, the total area of farm woodland in these parishes was 147 ha, which had risen to 207 ha in 1988. According to the questionnaire survey, several farmers had participated in the Farm Woodland Scheme. These developments are in accord with work on farmland elsewhere by Essex (1987) and MLURI (1992) who claim that although the area under woodland has been reduced under agricultural intensification, re-planting has been more prevalent than removal since the early 1980s.

The total area under semi-natural vegetation in the sample area in 1972 was 118 ha but all this was in Haddington and Prestonkirk in about 12 locations. During the period from 1972 to 1988, an area of 13 ha in Haddington out of 64 ha (20%) and in Prestonkirk about 18.5 ha out of total 54 ha (34%) was converted to arable land. On the whole about 27% of the area of the sample area under semi-natural vegetation in 1972 had been brought under arable land by 1988.

5.4.4 Removal of farm features

Various farm features which are integral components of the farm landscape have been removed due to intensification of agriculture. The farm features which were selected for this purpose are ponds/wells, dispersed trees and farm buildings. The greatest change has occurred in conjunction with arable farming. The removal of farm features is closely associated with an increase in the area of the farms where farmers have been adding new land and removing farm features such as farm buildings without residence and ponds/wells. This evidence is supported by the work of Westmacott (1984).

5.5 FARMERS' TRENDS AND RESPONSES UNDER THE CAP

The questionnaire survey comprises 28 farms in these four parishes with an area of 5076.1 ha, out of which 19 farms are arable. It represents primarily an intensive arable area of eastern Britain which has experienced landscape change associated with the intensification of agriculture under the CAP. Table 5.21 shows patterns of land use and land tenure in the area.

Table 5.21 Land use by farm type in East Lothian sample parishes

Type of farm	Arable	Arable/beef	Arable/stock	Beef	Total
Number of farms	19	3	5	1	28
Area (hectares)	3767.28	484.4	674.4	150	5076.08
No. of parcels	103	26	37	5	171
Land Tenure					0
Wholy owned	13	3	3	1	20
Wholy rented	5	0	2	0	7
Part owned/rented	1	0	0	0	1
Status of farm					
Full time	17	3	5	1	26
Part time	2	0	0	0	2
Farm business					0
Family	16	3	5	1	25
Family/Corporate	1	0	0	0	1
Total permanent Labour					
Male	58	10	13	1	82
Female	1	2	1	0	4
a. Family members					
Male	25	6	8	1	40
Female	0	1	1	0	2
b. Others					0
Male	33	4	1	0	38
Female	0	1	0	0	1
c. Full time (inc. a & b)					
Male	53	8	12	1	74
Female	0	1	0	0	1
d. part time (inc. a & b)					
Male	5	2	1	0	8
Female	1	1	1	0	3

Source: Questionnaire survey data

Only 28 farmers responded from the sample parishes. On the basis of farm types recognised, the farms are categorised under 4 types: arable (intensively crop-producing), arable/beef (crop-producing with some beef production), arable/stock (dominantly crop-producing with beef, sheep and pig); and beef (intensively beef producing). The highest number of farms (19 out of 28) are arable farms. The number of farms under arable/beef is three, under arable/stock five, with one under beef. The total area of these 28 farms is 5076 ha, of which 70% is under arable farms, 9.5% under arable/beef and 13.3% under arable/stock. Twenty farms are wholly owned by the farmers, 26 farms are full time and 25 farms are family business. In summary, a large majority of the farmers in the area are full-time family business focussing on crop-production.

The total labour on these 28 farms is 82 males and 4 females. The highest proportion of male labour (70%) is in arable farming. In arable farming 25 are family members and 33 are employed full time. There is a total number of 74 persons working on a full-time basis in arable farming. Only a few females are working on these farms, mostly as non-family members.

Table 5.22 presents the principal trends of agricultural intensification in the sample area. Intensification of crop production has been undertaken by 25 farmers out of 28. On the arable farms, 17 of 19 farms have intensified their crop production, most especially by increasing the area under wheat production. It can be seen that 18 out of 19 farmers have increased their area under wheat production and seven farmers have intensified oilseed rape and potato production. Only one farmer has decreased crop production. Field drainage, necessary to improve farm productivity, has been promoted by 15 farmers, of whom eleven are arable farmers. This shows that those farmers who had some poor drainage have improved their drainage system to intensify crop production. Field amalgamation which is an integral part of agricultural intensification has been undertaken by 21 farmers of whom 14 are arable farmers. Field amalgamation has also been undertaken by other types of farmers who have converted grassland to crop-producing areas through removing field boundaries

Table 5.22 Intensification of agriculture by farmers (No. of farmers)

Area increased by farms	Arable	Arable/beef	Arable/stock	Beef	Total
Increase	8	0	3	0	**11**
Decrease	4	1	1	0	**6**
No change	7	2	1	1	**11**
Field amalgamation	14	2	4	1	**21**
Increased field drainage	11	1	2	1	**15**
Intensification of crop production	17	3	4	1	**25**
Intensification of livestock production	1	2	3	1	**7**
Decrese in crop production	1	0	2	0	**3**
Decrease in livestock production	10	1	2	1	**14**
Intensification of crop since 1973					
Wheat	18	2	4	1	**25**
Barley	6	0	1	0	**7**
Oil seed rape	7	0	4	0	**11**
Potatoes	7	0	0	0	**7**
Intensification of livestock since 1973					
Beef cattle	2	0	3	1	**6**

Source: Questionnaire survey data

and increasing field drainage. Fourteen farmers have decreased their livestock production, none of whom were arable farmers. Only one arable farmer has increased livestock production when in a capacity to have concentrated on pig or poultry production alongside crop production.

Figures 5.4 and 5.5 illustrate the intensification of agriculture in respect of increases in tillage, wheat and oilseed rape. The area under wheat and oilseed rape has replaced the area under other crops such as barley and oats between 1972 and 1990. This trend is supported by the evidence of the farmers' responses from parishes where 21 farmers have amalgamated their fields and where 25 farmers have been intensifying crop production through increased field drainage and through use of capital grant schemes. There have been some minor changes in livestock production (Figures 5.6 and 5.7)

The intensification of agriculture in the East Lothian sample area has resulted in rural landscape change in several ways. Table 5.23 enumerates the pattern of change in the rural landscape features. The total number of farms which have different types of field boundaries are 24 (hedgerows), 20 (stone walls) and 24 (post and wire fences). In arable farming (19 of the 28 farms), they are 17 (hedgerows), 14 (stone walls) and 16 (post and wire fences). Only six farms in arable farming have tree-line and mixed boundaries. The total number of farmers who have amalgamated their farms and fields either to increase the area of the farms or to enlarge the fields is 21 out of 28. A majority (14) are arable farmers with a further four arable/stock farmers. The number of farmers who have removed their field boundaries are 15 (hedgerows), five (stone walls) and 14 (post and wire fences). Most of these farmers are either arable (11 for hedgerows, four for stone walls and nine for post and wire fences) or arable/stock farming (two for hedgerows and three for post and wire fences).

Other farm features present are farm buildings with residence (2), without residence (19), dispersed trees (14) and ponds/wells (12). There has been only limited removal of farm features on the farms. Only five farmers have removed dispersed trees and three farmers have removed farm buildings without residence.

Table 5.23 The pattern of rural landscape features (No. of farms)

	Arable	Arable/beef	Arable/stock	Beef	Total
Field amalgamation	14	2	4	1	**21**
Hedgerows	17	2	4	1	**24**
Stone walls	14	2	4	0	**20**
Post and wire	16	2	5	1	**24**
Tree line	6	0	1	0	**7**
Mixed boundary	6	0	2	0	**8**
Hedgerows removed	11	1	2	1	**15**
Stone walls removed	4	1	0	0	**5**
Post and wire removed	9	2	3	0	**14**
Tree line removed	1	0	0	0	**1**
Mixed boundary removed	0	0	0	0	**0**
Farm building with Res.	2	0	0	0	**2**
Farm building without Res.	15	0	4	0	**19**
Dispersed trees	11	1	2	0	**14**
Farm building without Res. removed	1	1	0	1	**3**
Dispersed trees removed	3	1	1	0	**5**
Pond / Well	10	0	2	0	**12**
Pond / Well removed	1	0	0	0	**1**

Source: Questionnaire survey data

The pattern of field amalgamation and removal of field boundaries at this smaller scale closely mirrors evidence for amalgamation of fields discussed for South

East Scotland on a whole where 101 fields have been amalgamated in the parishes during the period 1972 and 1988, and 21 out of 28 farmers have amalgamated their fields. The removal of hedgerows and post & wire field boundaries, which has been the major element of removal of field boundaries by farmers (15 for hedgerows and 14 for post & wire) also reflects those patterns of removal of hedgerows and post & wire boundaries in the rural landscape (Figure 5.17 and 5.18). This indicates that removal of field boundaries especially hedgerows and post and wire fences has been the main target of agricultural intensification. Other farm features which have been removed can be associated with the increase of the area by the farmers (11 of 28) who have removed the unnecessary farm features for enlarging farm size during the process of agricultural intensification for better productivity of their farms using the capital grant schemes.

Table 5.24 shows the trend of farmers' participation in different schemes offered by the CAP. Most involvement has been with capital grant schemes (FHDS, AHDS, AIS, F and CGS Schemes). The total number of farmers who participated in these schemes is 20 out of 28. The highest participation has been in the arable/beef sector where all three farmers participated. In other farms, 13 in arable and three in arable/stock participated in these schemes. This would suggest that these schemes have played an important role at the local scale, but variably within sectors of the agricultural economy, in the intensification of agriculture and its effects upon the rural landscape.

Another scheme which has a high rate of participation is the Set Aside Scheme (1988) where a total of 10 farmers participated. The purpose of this scheme was either to set aside some cultivated land for fallow or purposes other than cultivation. Most of the participants (7 of the 10) are arable farmers. The Farm Woodland Scheme is another scheme which has been adopted by farmers here, especially by arable farmers (4 out of 19). Farmers whose land was not capable of good crop production have planted woodland under this scheme. The participation of the farmers in other schemes has been nil. One of the reasons for this last statement is that the Farm Extensification Scheme was mainly offered to the hill livestock farmers, and the sample area is mainly a crop-producing area. It can be seen from Table 5.24 that only a few farmers regarded these other schemes as 'Bad'. Most

Table 5.24 Farmers responses towards the CAP (No. of farmers)

	Arable	Arable/beef	Arable/stock	Beef	Total
The 1973 Farm Amalgamation Scheme	0	0	0	0	**0**
FHDS, AHDS, AIS or FCGS Schemes	13	3	3	1	**20**
Pig Subsidy Scheme	0	0	0	0	**0**
The Farm Woodland Scheme	4	1	0	0	**5**
Set Aside Scheme (introduced 1988)	7	2	0	1	**10**
The Farm Diversification Scheme	0	0	0	0	**0**
The Rural Enterprise Programme	0	0	0	0	**0**
The Farm Extensification Scheme	1	0	0	0	**1**
First impression about CAP					**0**
Bad	4	1	1	0	**6**
Good	4	1	1	1	**7**
Neutral	8	1	2	0	**11**
No view	3	0	1	0	**4**
Change of price support policies					**0**
Bad	9	0	4	0	**13**
Good	2	0	1	0	**3**
Neutral	7	1	0	1	**9**
No view	1	2	0	0	**3**
Set Aside Scheme (introduced 1988)					**0**
Bad	14	2	4	1	**21**
Good	3	0	0	0	**3**
Neutral	1	0	1	0	**2**
No view	1	1	0	0	**2**
The Farm Diversification Scheme					**0**
Bad	3	1	0	0	**4**
Good	6	0	1	0	**7**
Neutral	4	0	3	0	**7**
No view	6	2	1	1	**10**
The Farm Extensification Scheme					**0**

Source: questionnaire survey data

farmers remained neutral or undecided largely because the schemes were not offered to them. On the other hand, those 10 farmers who participated in the Set Aside Scheme did so despite a large majority (21 out of 28) considering this scheme 'Bad' and only three regarding it as 'Good'. In arable farming, seven farmers participated in this scheme but only three farmers regarded it as 'Good'. Fourteen farmers considered the scheme 'Bad'. Chief amongst the stated reasons why participation was high for a scheme considered bad was that the changes in price support policy have forced farmers to adopt other ways of income generation on their land, especially when the possibility of farm enlargement is not a realistic option.

A major change can be seen, however, in respect of farmers' views about the CAP. Most farmers (11) were neutral or undecided (4) at the time of accession to the CAP. Only seven farmers were in favour and 6 farmers were against the CAP. In 1988 when the CAP changed its price support policy, 13 farmers were against the change while three were in favour of change along with 9 farmers who remained neutral and 3 farmers who remained undecided. This shift in support suggests that farmers were quite comfortable under the earlier price support system of the CAP because of guaranteed higher prices for their agricultural products.

5.6 ANALYSIS OF RESULTS

The results of agricultural and rural landscape change have been presented earlier in this chapter. The purpose of the examination of agricultural change was to probe the extent of agricultural change at a representation parish level. The main aim of this chapter was to examine the rural landscape change in East Lothian. The results of these two data sets revealed the factors lying behind the agricultural and landscape change. Interpretation and analysis of these results is discussed here in the following sections.

5.6.1 Agricultural change

Although the purpose of examining agricultural change was to concentrate upon the extent of change, it is relevant to begin considering the major factors affecting agricultural change. They are summarised and discussed here briefly:

1. Changes in land tenure and structural policies that have been influential in reducing the number of farm holdings;
2. Economic incentives that have encouraged the farmers to put greater areas under tillage, cereals and oilseed rape, changing the cropping patterns in the area;
3. Higher prices for wheat that have determined the patterns within cereals;
4. Physical factors that have affected the extent of agricultural change in the area;
5. The availability of capital grants and other schemes that have been influenced the nature of agricultural patterns;

Land tenure, physical environment, economic incentives of the CAP and farmers' own decisions have changed the cropping patterns in the area. Changes in land tenure led to the decline of farm holdings and increase in average farm sizes. The changes in land tenure are due to a number of factors such as structural policies, decline in farm holdings, agricultural intensification, higher prices, expensive labour costs and farmers' own decisions. All these factors are discussed here one by one. The Farm Amalgamation Scheme (1973) and Payments to Outgoers Scheme (1976) encouraged small farmers, who were not able to carry out agricultural intensification, to sell their farms to other large farmers. Changes in land tenure were also affected via increases in the rent of land or refusal to extend the leases of land by landlords because of the chances of higher profits under the price support system. It is also possible that some farmers may have decided themselves not to continue farming because of other social or family matters. A major reduction in the number of farm holdings also influenced the land tenure pattern. Expensive labour costs or non-availability of labour for old or single farmers, may have contributed to the reduction of farm holdings in the area.

Higher prices for wheat and oilseed rape influenced the cropping patterns (Tables 5.2 and 5.3). These higher prices were offered under the CAP's price support system. The variations in prices for crops led to marked change in cropping patterns. Although higher prices for cereals, especially for wheat and later for oilseed rape, contributed to the reduction of the area under grass and rough grazing and increases in the area under tillage, there are physical characteristics (soil, topography and climate) which play a powerful role in determining the extent of agricultural change result in variations between and in the parishes. There is no doubt that these physical factors have a limit beyond which they do not support cultivation of certain crops but some of them, such as soils, can be improved to some extent for cereal crops.

Moreover, the availability of capital through capital grant schemes for the improvement of farm land and its structure (improving field drainage system and buying big machinery) also affected the extent of agricultural change. The improvement of farm structure and improving field drainage has played a major part in the sample area. These inter-related patterns suggest that the physical factors underlying agriculture have been less effective than economic incentives together with social and behavioural factors in influencing farmers' decisions in the East Lothian case study.

Examination of agricultural change (Tables 5.2 to 5.5 and Figures 5.4 5.7) suggests that agricultural intensification and land tenure changes resulted in a distinctive rural landscape change, which is discussed in the following section.

5.6.2 The rural landscape change

The analysis of rural landscape data brought major factors to light which have been influencing the nature of rural landscape in the area. The main findings are:

1. There has been high level of field amalgamation, except in Morham;
2. Physical characteristics (soils, topography and climate) have been the main determinants in the nature of field amalgamations;
3. Decline in farm holdings and changes in land tenure have affected the patterns of field amalgamation;
4. Intensification of crops and changes in cropping patterns are the most important factors in the process of field amalgamation;
5. The availability of capital for farm improvement has also contributed in the process of field amalgamation and removal of farm features;
6. Size of the parishes reflected the extent of field amalgamations in the parishes;
7. Significant removal of hedgerows and post & wire fences because of field amalgamations;
8. Some replacement of post & wire fences by hedgerows;
9. Lesser levels of removal of other boundary types;
10. Some new appearance of tree line and vegetative belt boundaries;
11. Significant removal of traditional farm features and a decrease in the area under woodland and semi-natural vegetation;

The major findings listed above can be categorised into three main groups. The first six findings fall within the theme of field amalgamation; the next four can be described as changes in field boundaries and the last one affects the traditional appearance of them in the landscape. These groups of findings will be discussed here one by one.

The first finding in the field amalgamation group, explains the nature and extent of amalgamation whilst the rest of the findings are the factors behind the process. The patterns of field amalgamations in the sample area as a whole and for individual parishes, are presented in Tables 5.6 to 5.8 and in Figures 5.8 to 5.10. They have shown the nature of field amalgamations, where small fields have coalesced to create large fields in the parishes. Athelstaneford, Haddington and Prestonkirk have shown higher number of field amalgamations whilst Morham showed only a few amalgamations. It is very important to know the locations of these field amalgamations in the parishes before examining the casual factors. The locations of field amalgamation will also reflect the link between physiography of study area and field amalgamations.

Most field amalgamations have occurred in those parts of the parishes (Figures 5.2 and 5.10) where soil and field drainage can be improved; these areas come under class 2 and 3_1 of the LCA which can support and improved for cereal crops (Figures 5.3 and 5.10). In Athelstaneford, amalgamations are carried out in those parts which have soil type 331. The whole of Athelstaneford parish comes under class 2 of the LCA. In Haddington, amalgamations are carried out mainly in those parts which have soil type 444 and come under class 2 of the LCA. In Prestonkirk, amalgamations are done mainly in areas of soil type 331 and class 3_2 of LCA. Morham has only a few amalgamations and this parish comes under soil type 466 and class 3_1 of the LCA. These patterns suggest that soil type 331 and 444 have been important in field amalgamations. Soil type 331 is found in Athelstaneford under class 2 but in Prestonkirk it is present under class 3_2. This disparity is mainly because of height of those area in both parishes. The amalgamations in Athelstaneford have occurred below 60m amsl while in Prestonkirk they occur above 60m amsl. In Haddington, soil type 444 is found up to 60m amsl which means that soil type and altitude have been main determinants of field amalgamations. This trend reflects the fact that field amalgamation is carried out mainly for bringing a greater area into wheat production or the changing cropping patterns. The location of field amalgamations suggests that the parent material, soil characteristics and the nature of topography physical factors have been very important in determining the nature and extent of field amalgamation within and between Athelstaneford, Haddington and Prestonkirk. Field amalgamation can not be carried out if the underlying soil does not support the crop intended to be intensified. The nature of the underlying terrain may force farmers to restrict field amalgamations. Other factors (height above mean sea level and climate) decide the nature of crops and alternatively influence the extent of field amalgamation. Morham, which has most of its area above 100m amsl and comes under class 3_1 of the LCA, has had fewer amalgamations but more probably, there are some other factors which have also restricted field amalgamations - such as number of farms and farmers' decisions.

Changes in the number of farms and in land tenure are other major factors which have contributed to the amalgamation farms and fields. Buying and selling some area of the farms often results in the process of field amalgamation. A major change in farm holdings (Table 5.1) is one of the main causes. A large number of field amalgamations (99) and decline in the number of farms (43), reflects that decline in number of farm holdings is a very important factor in determining the field amalgamations within the parishes. More importantly, this factor contributed to restrict field amalgamation in Morham, where no change in the number of farm holdings was evident between 1972 and 1990. Change in the area of farm is another reason for amalgamation. In all parishes, the area owned by farmers has risen while area rented from outside concerns and from near-relatives has declined. These changes in land tenure are mainly because of intensification of crops, structural policies and availability of grants for improving farm structure. When new land is added, farmers can amalgamate some of fields - not only to enlarge field size but also because of changes in the farm boundaries.

The intensification of crops (Table 5.2 and Table 5.22) has been one of the main factors in the process of field amalgamation in the sample parishes. Wheat and oilseed rape are principal crops which have been intensified in all parishes. An increase in the area of certain crops means that some new area is being added from other crops. This change has forced the farmers to amalgamate some fields into larger fields. Change in the cropping patterns has been another major factor. For example, a reduction in the area of barley, oats or potatoes in order to increase the area of wheat, will influence the farmers to amalgamate the fields for the purpose of ease of farm machinery, use of pesticides and field drainage system. Change in cropping pattern has created some very large fields especially in Prestonkirk (Figure 5.12). The introduction of new large farm machinery on the farms has been another major factor which forced the farmers to amalgamate the fields, even if there were no economic incentives for field amalgamation. The reduction of human labour, saving of time and, more importantly, the availability of additional land from field amalgamation has encouraged the farmers to aggregate their fields.

The availability of capital for the improvement of farm structure is another factor influencing the process of field amalgamations in the sample area (Table 5.23). This encouraged farmers to augment those parts of the farms under arable, by improving field drainage or by some form of soil improvement using fertilisers and pesticides or large farm machines. This case has appeared in the sample parishes, where some semi-natural land has been improved for arable purposes - especially in Haddington and Prestonkirk. Although it is very difficult to point out which field amalgamation is related to which cause, in general, physical characteristics, land tenure change and intensification of crops have been the main factors.

One factor which has caused the variation between the sample parishes is the size of the parish and number of farms in the parish. Large parishes such as Haddington, with a higher number of farms than a small parish, also witmessed a large number of field amalgamations (Table 5.10). These field amalgamations have been carried out for the enlargement of fields for the better use of large farm machines and to bring greater areas under wheat and oilseed rape production.

In spite of all these factors, farmers' own behaviour is the most important factor behind the field amalgamations.It cannot be ignored that such decisions are also dependent upon the physiography of area and the extent of economic incentives for field amalgamations. However, the questions how many fields should be amalgamated? Where to amalgamate? To what extent should there be to amalgamation?, - all depend upon the farmers' own personal decisions.Despite this, the data from the questionnaire survey in the sample area suggest that field amalgamations have been carried out mostly on arable and mixed arable (Table 5.23), where 75% of farmers amalgamated their fields.

The second group of major findings is comprised of changes in field boundaries. Changes in the field boundaries reflect two patterns: field boundaries that have been removed with or without field amalgamations. Hedgerows and post & wire boundaries have been the main target of change in field boundaries. Both types of boundaries have witnessed removal but only where hedgerows have been the boundaries have new plantings been made(Table 5.8). It also appears that that this new replanting of hedgerows has occurred everywhere in the parishes.

A comparison of Figures 5.10 and 5.14 suggests that removal of hedgerows has been a part of field amalgamation. These patterns are reflected in amalgamation of fields in Athelstaneford and Morham which are almost entirely based on hedgerows removal whereas, in Haddington and Prestonkirk removal takes place on hedgerows and post & wire fences(Table 5.15). On the other hand, although some removal of post & wire fences is due to field amalgamation, a large number of post & wire boundaries (Table 5.16) have been replaced by new plantings of hedgerows. It is hard to find the exact reason for this variation but differences between parishes relate to the nature of field amalgamation, topography, soil characteristics and more importantly, because of the farmers' own decisions. Although the removal of hedgerows is associated with field amalgamation in the parishes, it should be remembered that variations between parishes are due to intensity of change in cropping patterns which depend upon the physical characteristics of farms.

Although, the new appearance of hedgerows is result of capital grants (AIS) as mentioned by Blunden and Curry (1988), the locations of these new replanting are most probably farmers' own decisions depending upon the socio-behavioural factors as well as physical characteristics of their farms. Although the size of parishes, number of farms in the parish and cropping patterns in the parish have influenced the extent of change in hedgerows and post & wire boundaries, the farmers' participation in capital grant schemes has also been important.. For example, Morham has shown more new hedgerows than Haddington (Table 5.12). This variation, in spite of the difference of parish sizes, reflects a personal decision to replant new hedgerows.

Post & wire fence boundaries have been removed as a part of field amalgamation but mostly they have been replaced by new hedgerows (Figure 5.15). The planting of hedgerows has an advantage over post & wire boundaries because of its capability to prevent soil erosion and as wind breaker. Thus, availability of grants through Capital Grant Schemes, has encouraged farmers to plant new hedgerows, though some of new plantings may have occurred because of farmers' own decisions rather than because any incentives.

Removal and addition of all other boundaries are less significant than hedgerows and post & wire boundaries. This is because of historical nature of field boundaries where hedgerows boundary has been a part of fields. Some new addition of vegetative belt and tree line boundaries also suggest farmers' attitudes to improve the landscape. Stone walls boundary has not created because of its cost and labour. These patterns of field boundaries change are further supported by farmers' responses from the area (Table 5.24) where (71%) farmers have removed their boundaries.

Moreover, there have been changes in farm features (dispersed trees, farm buildings and ponds/wells) which are closely related with the intensification of agriculture through the improvement of farm structure or enlargement of fields. Some area of semi-natural vegetation has been brought under arable due to agricultural intensification. The examination of woodland area in the sample area shows coniferous woodland to have increased while broad-leaved woodland has declined (Table 5.21). Although this data does not represent the change for whole sample parishes especially in Haddington it does show that the area under coniferous woodland has increased (Figure 4.9). On the other hand, the area under farm woodland in the parish summaries has also increased. It can be deduced from the patterns that coniferous plantation has risen in the area. The Farm Woodland Scheme 1985 has encouraged farmers to plant woodland though new planting appears to be of coniferous woodland. This is because of its advantage over broad-leaved woodland (rapid growth). In spite of higher incentives for broad-leaved the plantation of coniferous shows that farmers have been given preference to coniferous and also because they were able to get tax concessions from government.

5.7 SUMMARY

The evidence reviewed here for the East Lothian parishes shows that farm holdings have decreased in number between 1972 and 1988 but increased between 1988 and 1990. Major changes have been found in the area under crops, grass and rough grazing. The area under tillage, arable and cereals has increased. The area under wheat production has increased since 1972. The area under oats, barley and potatoes has decreased between 1972 and 1990. Oilseed rape increased between 1984 and 1988 but decreased between 1988 and 1990. The area under crops for mowing and not for mowing and rough grazing has also declined. Dairy cattle are not a major part of East Lothian agricultural activity. The production of beef cattle has declined but the production of sheep production has increased in the parishes. Pig and poultry production has also decreased between 1972 and 1990.

There have been substantial changes to field sizes and in field numbers due to field amalgamation. Some large fields have been created. There has been a high level of activity in removing and replacing field boundaries. Hedgerows have been removed and re-planted. Post & wire fences as field boundaries have been greatly reduced in extent in all parishes. Post & wire fences have been chiefly removed for the purpose of field amalgamation and for the re-plantation of hedgerows. Other farm features have been removed although this activity has been on a small scale. Some new woodland has been planted, and some areas of semi-natural vegetation have been improved and cultivated.

Farmers have intensified crop production especially in wheat and oilseed rape. Most farmers have increased their field drainage and participated in capital grants schemes. Some of them have also participated in the Farm Woodland Scheme. A large majority of farmers have removed field boundaries, especially hedgerows and post & wire fences. Hedgerows have been the main focus of boundary renewal. Change in price support have not been welcomed.

CHAPTER 6

RURAL LANDSCAPE CHANGE IN BERWICKSHIRE

6.1 INTRODUCTION

In chapter 5 rural landscape change in East Lothian sample area was examined. This chapter examines rural landscape change in the second sample area, located in Berwickshire.

6.2 STUDY AREA

The study area consists of four civil parishes, Ayton, Eyemouth, Bunkle & Preston and Chirnside. The area of these parishes covered in the aerial photographs is about 8000 ha, of which 5500 is arable. Figure 6.1 shows the study area. The sample area has some land 200m above mean sea level but almost all is under 150 metres above sea level.

Figure 6.2 shows the soil types in the area. The soils of Ayton are three types: soil type 77, 196, and 209. The first two types are developed mainly on drifts derived from lower Old Red Sandstone rocks which include sandstones. Both the gentle slopes and warm moderate climate with low average rainfall (700 mm p. a.) favour arable agriculture. Pastures and long ley grassland are common where rock is near the surface, but elsewhere the land is generally farmed in rotations including a major proportion of arable crops. Soil type 209 is Brown Forest Soil developed from drifts derived from Lower Palaeozoic greywackes and shales. The soil is found on the foothills and the undulating lowlands. The soils in Eyemouth and in some parts of Ayton are brown forest soils, developed on modified stony tills, and brown forest soils and some brown forest soils with gleying. The climate ranges from warm and moderately dry to fairly warm and wet (with about 750 mm p.a. average rainfall) and, although much of the land has been cultivated for arable crops, the semi-natural vegetation is generally acid bent-fescue grassland. The freely-draining conditions in the loamy soils, the moderate elevation and absence both of steep slopes and or

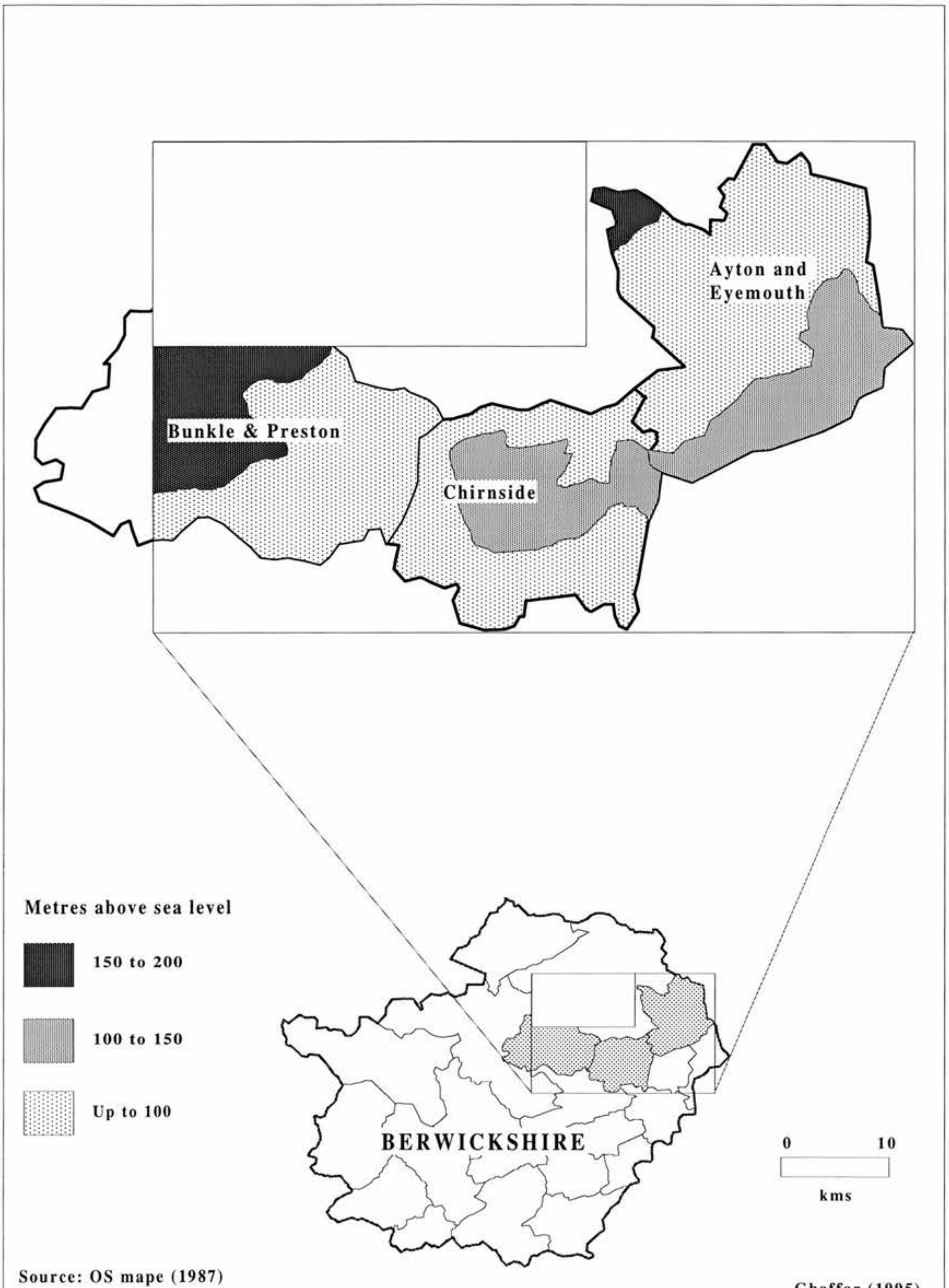


Figure 6.1 Rural landscape study area in Berwickshire

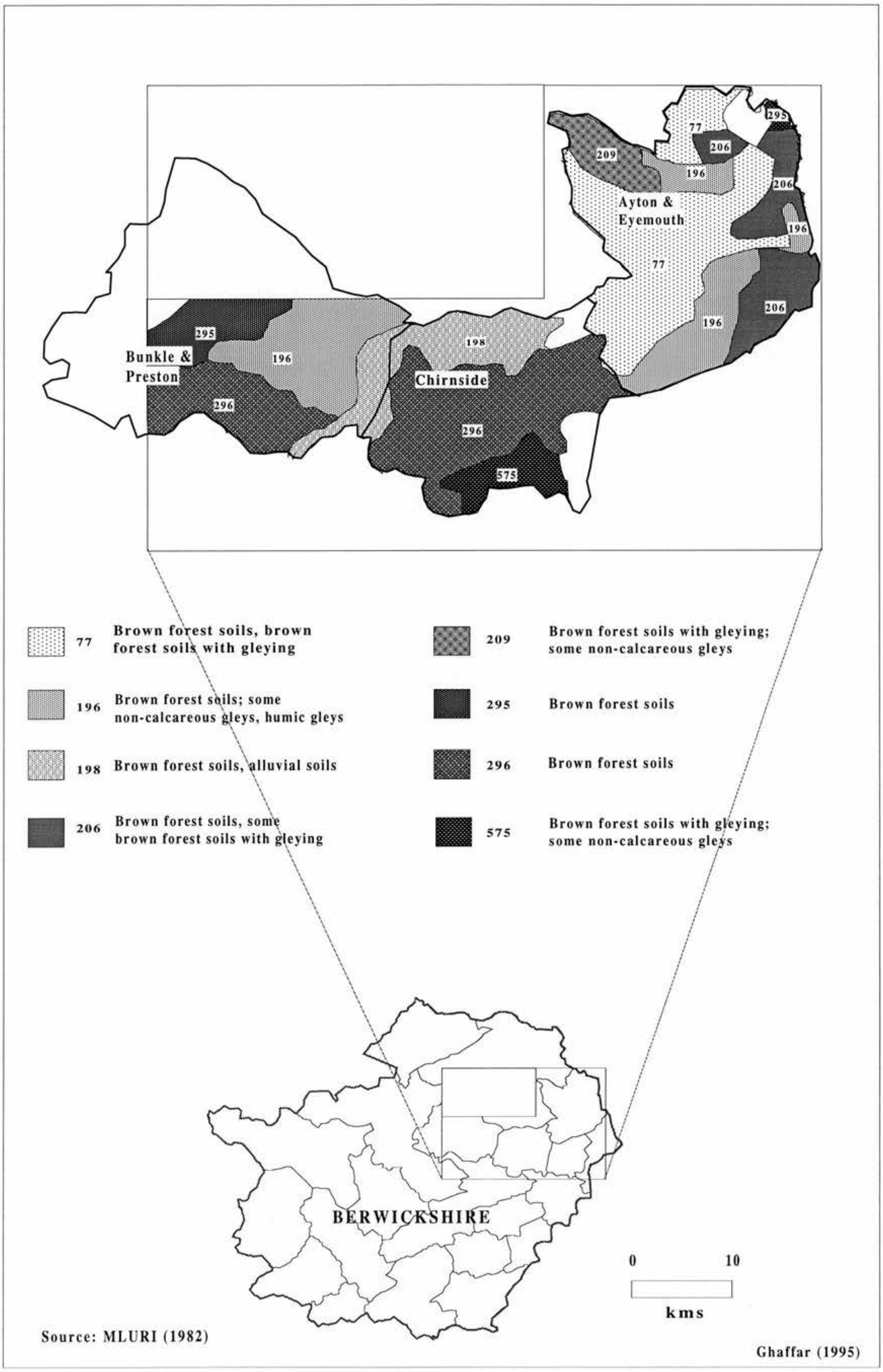


Figure 6.2 Soil types in Berwickshire sample area

extremes of climate are favourable to cultivation. The soils of Chirnside and in some parts of Bunkle & Preston are mainly brown forest soils (soil types 198, 296 and 575), with some non-calcareous gleys and humic gleys, developed on sandy loam drifts, which are generally thin. These conditions of soil, climate and topography are well suited to the needs of arable farming and the land is generally highly productive for a range of crops which includes barley, wheat, turnips and potatoes. The rest of the land in Bunkle & Preston has a combination of brown forest soils and alluvial soils (soil types 196, 206 and 295).

The alluvial soils on the river flood plains range widely in texture and natural drainage, but are generally loams and sandy loams, often overlying gravels, and have free or imperfect drainage. The soils of the eastern and north-eastern parts of Bunkle & Preston are brown forest soils developed mainly on red-brown fluvioglacial sands. The land is low lying. Under the warm dry climatic conditions the soils, generally of sandy loam texture in the surface layers, are easily cultivated and arable crops can be established readily.

Figure 6.3 shows the land capability classification for agriculture in the area. Some areas in central Chirnside and the southern part of Bunkle & Preston come under class 2. Cropping is very flexible and a wide range of crops can be grown but the land is better suited to winter-harvested crops. The level of yields is high but less consistently obtained than class 1 due to limitations in workability, wetness problems, slightly unfavourable soil structure or texture, moderate slopes and local micro-climate. Limitations are, however, always minor in their effects and land in this class is highly productive. The rest of the land in these parishes and in some of Ayton & Eyemouth is class 31, capable of producing a moderate range of crops. The land is capable of producing consistently high yields of a narrow range of crops (principally cereals and grass) and/or moderate yields of a wider range including potatoes and oil seed rape. Short grass leys are common. The degree of variability is greater than class 2 due to interactions between climate, soil and management factors affecting the timing and type of cultivation, sowing and harvesting. The moderate limitations require careful management and include wetness, restrictions to rooting

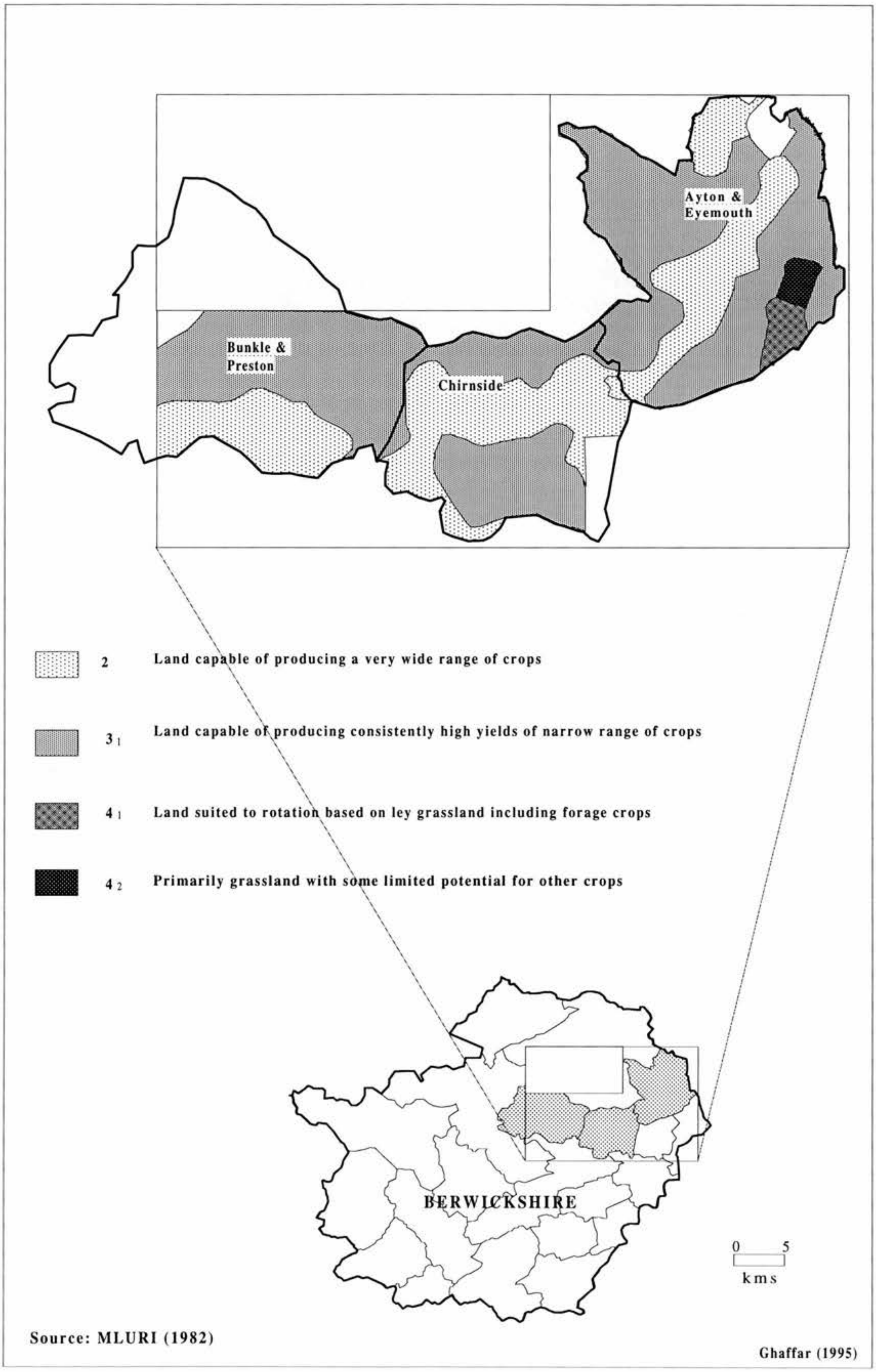


Figure 6.3 Land capability for agriculture in Berwickshire sample area

depth, unfavourable structure or texture, strongly sloping ground, slight erosion or a variable climate. A major part of Ayton is class 41 land, which is suited to rotations, including forage crops and cereals for stock feeding. Yields of grass are high. Other crops yields are variable and usually below the national average.

6.3 AGRICULTURAL CHANGE

Historically, Berwickshire is a sheep-producing area. Great changes in farming methods occurred after 1760, first in the Merse. In addition to better methods of cultivation, new and improved crops were introduced by Fordyce of Ayton. According to the 1866 Agricultural Returns, the area under tillage was about 25 % of arable land which rose to 41% in 1933 and 49% in 1973. Agriculture in Berwickshire has gone through several changes since 1973.

6.3.1 Crop, grass and rough grazing

There have been changes in the number of farm holdings in the study parishes. In Ayton & Eyemouth, the number of farm holdings decreased by 21% and in Chirnside by 10 % but Bunkle had a 7% increase. The highest decrease was in Ayton & Eyemouth where six farms (from 21 to 15) were amalgamated. Table 6.1 shows agricultural change in these four parishes. The area under tillage, arable, cereals and wheat has increased in all parishes. Wheat had the highest rate of change between 1972 and 1990. The area under grass for mowing and rough grazing increased in Ayton & Eyemouth and Chirnside but decreased in Bunkle & Preston. There were fluctuations during this period in the area under barley production in Ayton & Eyemouth and Bunkle & Preston. The area under barley increased in Chirnside. Oats production declined in all parishes. Some problematic figures were found for the 1976 in Ayton & Eyemouth when the area under tillage suddenly increased from 1,795 ha to 3,764.3 ha also influencing the area under barley, cereals, arable, grass and rough grazing. No evidence has been found for this sudden increase (although it may be pointed that the explanation probably lies in inclusion of this parish with other parishes).

Table 6.1 The patterns of land use in sample parishes (ha)

Ayton & Eyemouth

	Wheat	Barley	Oats	Cereals	Oil seed rape	Tillage	Crops	Grass for mowing	Grass not for mowing	Rough grazing	Potatoes	Farm holdings	Agricultural land
1972	191.7	1148.7	174.2	1514.6		1795	1795	215.8	572.5	8.6	54.4	21	2583.3
1976	357.2	2541.4	115.6	3014.2		3764.3	3762.8	680.1	1704.5	341.6	83.8	19	6150.4
1980	356.7	1323.9	30.2	1710.8		2053.2	2052.4	322.2	397.5	102.6	32.8	18	2773.7
1984	517.2	1288.7	44.2	1850.1	63.5	2286.5	2282.9	276.1	318	36.5	36.1	20	2884.2
1988	576	1309.9	67.1	1953	87.6	2312	2311.5	244.2	339.1	35.1	22.2	15	2895.8
1990	532.1	1065.1	32.7	1629.9	147.9	2109.5	2083.4	242.8	386.8	29.8	29.9	15	2765.2

Bunkle & Preston

	Wheat	Barley	Oats	Cereals	Oil seed rape	Tillage	Crops	Grass for mowing	Grass not for mowing	Rough grazing	Potatoes	Farm holdings	Agricultural land
1972	160	930.1	137	1227.1		1507.2	1507.2	273.7	1146.8	391.8	70.7	13	2927.6
1976	110.7	1102.8	59.5	1273		1638.9	1638.9	306.3	1079.5	291.3	33.3	14	3024.7
1980	206.9	1194.2	25	1426.1		1715	1715	368.7	1088.9	126.8	35.9	14	3172.6
1984	331.9	1323	15.3	1670.2	75.2	2090.6	2090.6	277	815.5	118.6	43.8	14	3183.1
1988	408	1042.1	104.9	1555	60.4	1985.8	1935.2	203.3	1107.5	61.5	32.2	15	3347.2
1990	445.9	841.2	57.5	1344.6	58	1740.9	1740.9	162.6	1208.1	62.1	29	15	3111.6

Chirnside

	Wheat	Barley	Oats	Cereals	Oil seed rape	Tillage	Crops	Grass for mowing	Grass not for mowing	Rough grazing	Potatoes	Farm holdings	Agricultural land
1972	146.8	580.5	139	866.3		1070.6	1067	120.2	643.9	74.8	59.1	10	1838.2
1976	104.3	712.1	57.7	874.1		1091.4	1089	136	592.2	70.2	22.7	10	1822
1980	154.9	843.2	18.1	1016.2		1235.9	1235.9	139.7	474	66.5	42.2	10	1849.6
1984	478.7	679.4	6.4	1164.5	87.3	1479.7	1479.7	101	310.4	35.2	58.3	10	1891.1
1988	438.9	749.9	36.1	1224.9	127.8	1551.6	1551.6	80.7	283.5	29.5	58	9	1915.8
1990	467.1	794.7	0	1261.8	65	1555.6	1555.6	70.1	52.8	265.1	49.2	11	1890.8

Source: Derived from Agricultural Returns

*** Oilseed rape introduced since 1984.**

Figure 6.4 shows the proportion of land use between the period 1972 and 1990. The area under tillage increased in all parishes but the area under rough grazing decreased in Bunkle & Preston. Minor changes in the proportion of grass also occurred. Figure 6.5 shows the changes in the proportion of major crops in the parishes. The proportion of wheat increased substantially in all parishes. The proportion of barley and potatoes decreased in Ayton & Eyemouth and Bunkle & Preston. Minor changes in the proportion of other crops occurred between 1972 and 1990. Table 6.2 shows patterns of land use as a percentage of agricultural land.

The area under tillage and arable use increased enormously in Chirnside (58.24% to 82.27%). The area under grass and rough grazing declined in all parishes between 1972 and 1990. The area under wheat and oilseed rape and all cereals increased in all parishes, almost certainly as a result of the intensification of crop production. The area under barley and oats decreased, especially under oats which disappeared altogether in Chirnside.

6.3.2 Livestock change

Table 6.3 shows the patterns of livestock production in the area. Sheep and beef rearing is the main agricultural activity. On the whole, there has been a reduction in livestock production. Sheep production has declined in Ayton & Eyemouth and Chirnside, excepting the unusual year of 1976 when a very high increase was noticed in livestock production in Ayton & Eyemouth. Sheep production rose in Bunkle & Preston between 1972 and 1990 although there has been evidence of decline during this period. The production of beef cattle increased in Bunkle & Preston but declined in the other parishes. Figure 6.6 shows the percentage change in livestock production in the area. Pig production declined in Ayton & Eyemouth and Chirnside and, indeed, ceased by 1990. Pig production rose in Bunkle & Preston between 1972 and 1990. Poultry production was reduced in all parishes especially in Bunkle & Preston where it declined from 29763 fowls to 73 between 1972 and 1990. Figure 6.7 shows the proportion of cattle, sheep and pigs in the area. In Ayton & Eyemouth the proportion of cattle increased at the expense of sheep. Figure 6.8 shows the proportion of dairy

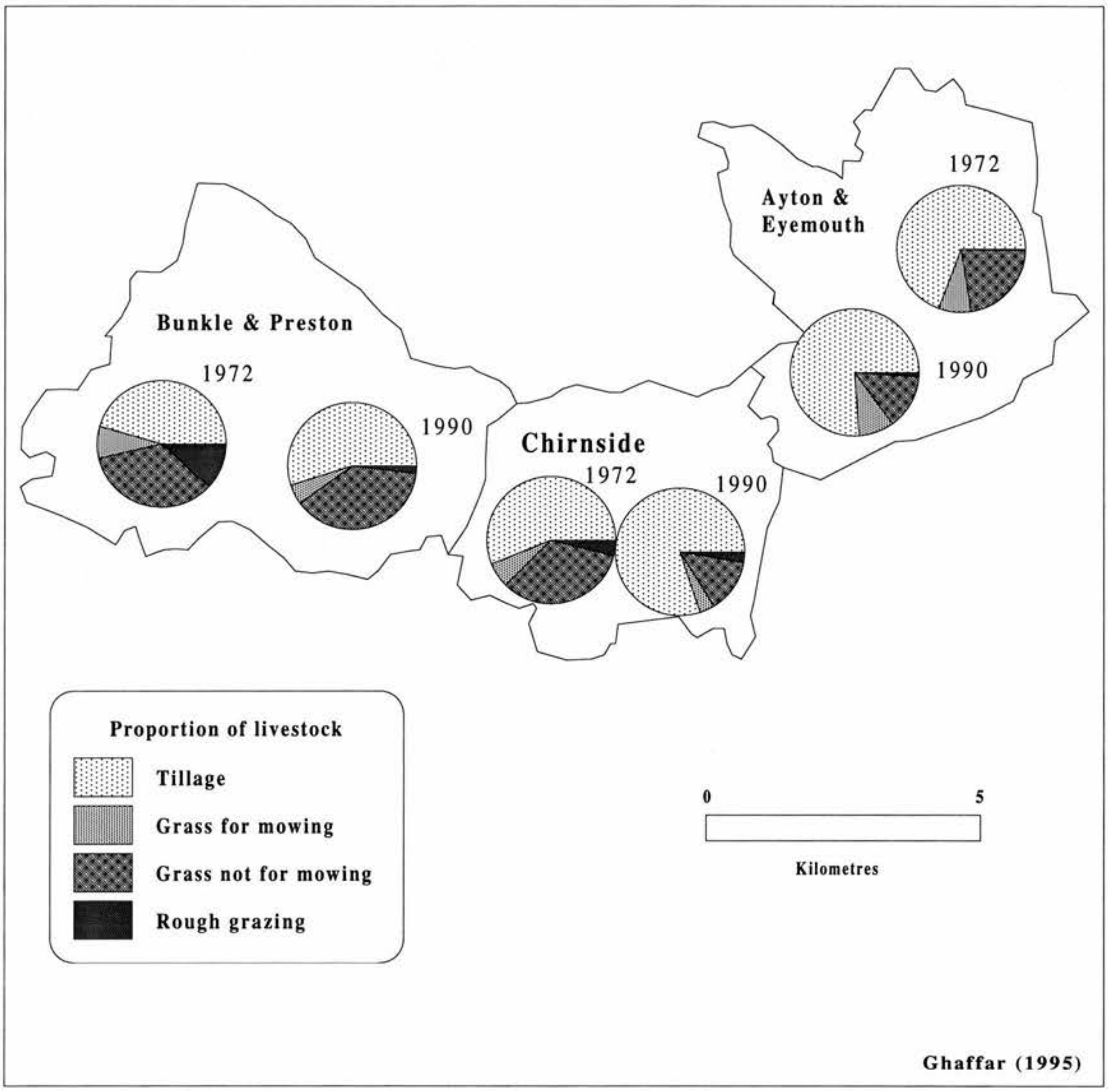


Figure 6.4 Proportional change inland use between 1972 and 1990

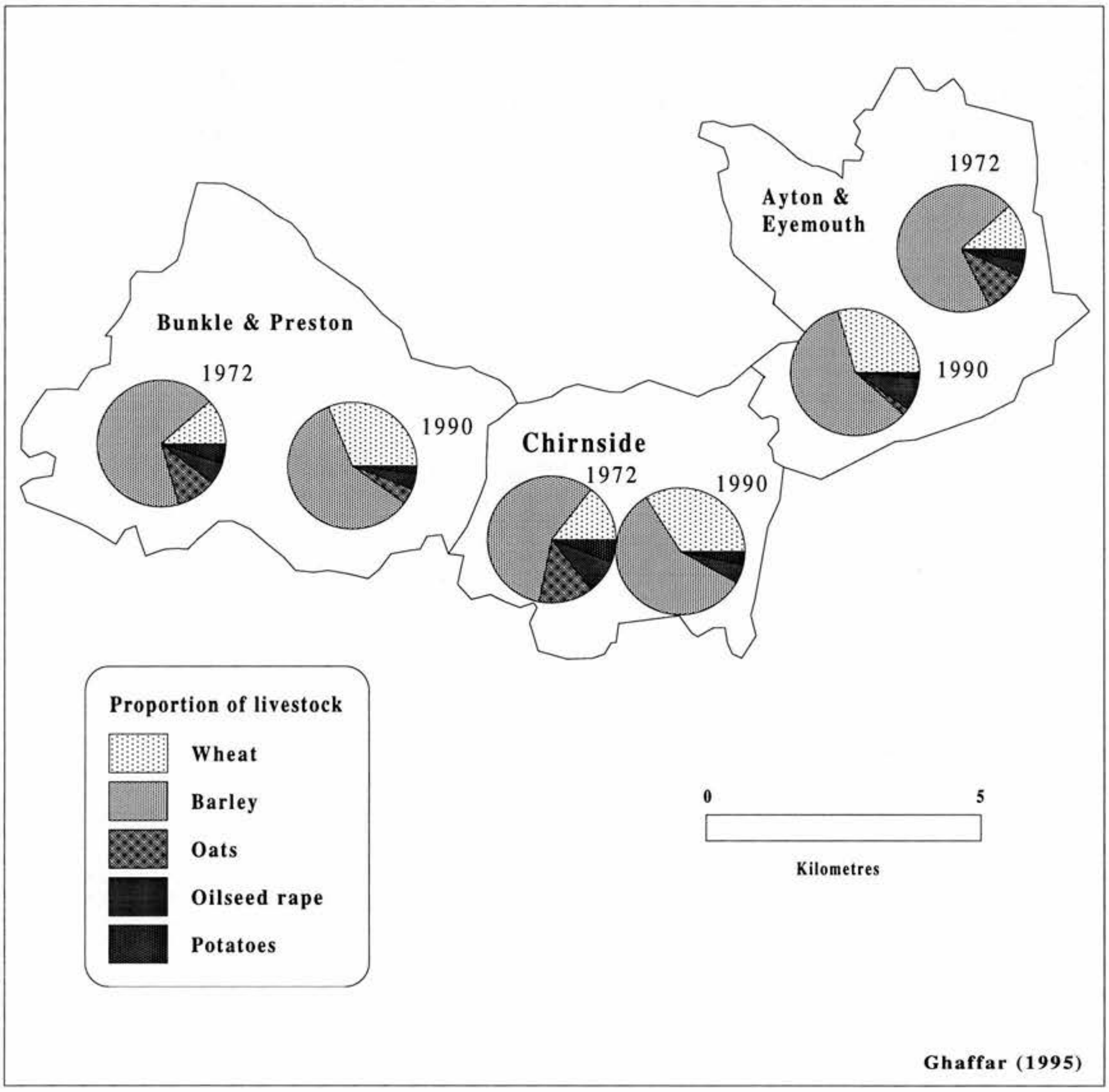


Figure 6.5 Proportional change in major crops between 1972 and 1990

Table 6.2 Land use as a percentage of agricultural land*

Ayton & Eyemouth

	Wheat	Barley	Oat	All Cereals	Oilseed Rape	Tillage	Arable	Grass for mowing	Grass not for mowing	Rough Grazing
1972	7.42	44.47	6.74	58.63	0.00	69.48	69.48	8.35	22.16	0.33
1976	5.81	41.32	1.88	49.01	0.00	61.20	61.18	11.06	27.71	5.55
1980	12.86	47.73	1.09	61.68	0.00	74.02	74.00	11.62	14.33	3.70
1984	17.93	44.68	1.53	64.15	2.20	79.28	79.15	9.57	11.03	1.27
1988	19.89	45.23	2.32	67.44	3.03	79.84	79.82	8.43	11.71	1.21
1990	19.24	38.52	1.18	58.94	5.35	76.29	75.34	8.78	13.99	1.08

Bunckle & Preston

	Wheat	Barley	Oat	All Cereals	Oilseed Rape	Tillage	Arable	Grass for mowing	Grass not for mowing	Rough Grazing
1972	5.47	31.77	4.68	41.91	0.00	51.48	51.48	9.35	39.17	13.38
1976	3.66	36.46	1.97	42.09	0.00	54.18	54.18	10.13	35.69	9.63
1980	6.52	37.64	0.79	44.95	0.00	54.06	54.06	11.62	34.32	4.00
1984	10.43	41.56	0.48	52.47	2.36	65.68	65.68	8.70	25.62	3.73
1988	12.19	31.13	3.13	46.46	1.80	59.33	57.82	6.07	33.09	1.84
1990	14.33	27.03	1.85	43.21	1.86	55.95	55.95	5.23	38.83	2.00

Chirnside

	Wheat	Barley	Oat	All Cereals	Oilseed Rape	Tillage	Arable	Grass for mowing	Grass not for mowing	Rough Grazing
1972	7.99	31.58	7.56	47.13	0.00	58.24	58.05	6.54	35.03	4.07
1976	5.72	39.08	3.17	47.97	0.00	59.90	59.77	7.46	32.50	3.85
1980	8.37	45.59	0.98	54.94	0.00	66.82	66.82	7.55	25.63	3.60
1984	25.31	35.93	0.34	61.58	4.62	78.25	78.25	5.34	16.41	1.86
1988	22.91	39.14	1.88	63.94	6.67	80.99	80.99	4.21	14.80	1.54
1990	24.70	42.03	0.00	66.73	3.44	82.27	82.27	3.71	2.79	14.02

Source: Derived from Agricultural Returns

*** Agricultural land includes all crops, fallow and grassland, but excludes rough grazing.**

Therefore the propotion under arable, grassland and rough grazing does not sum to 100%.

Table 6.3 The patterns of livestock and labour in sample parishes

Ayton and Eyemouth

	Dairy cattle	Beef cattle	sheep	Pigs	Total poultry	Labour
1972	1	1901	3624	203	685	79
1976	0	5132	13757	1509	72013	183
1980	28	2459	2763	15	147	69
1984	7	1713	1924	14	90	68
1988	0	1725	1638	0	104	53
1990	0	1826	1863	0	91	47

Bunckle & Preston

	Dairy cattle	Beef cattle	Sheep	Pigs	Total poultry	Labour
1972	1	2048	10741	686	29763	84
1976	0	2868	8655	1139	71795	91
1980	0	2966	9102	1122	23554	85
1984	0	2745	8302	1189	4485	71
1988	0	2030	11106	850	64	61
1990	0	2203	16439	832	73	55

Chirnside

	Dairy cattle	Beef cattle	Sheep	Pigs	Poultry	Labour
1972	1	1062	6569	188	276	45
1976	22	913	6824	120	182	45
1980	1	953	6568	48	46	42
1984	20	767	3690	0	45	33
1988	80	504	4178	0	23	31
1990	49	664	4154	0	8	43

Source: Derived from Agriculrural Returns

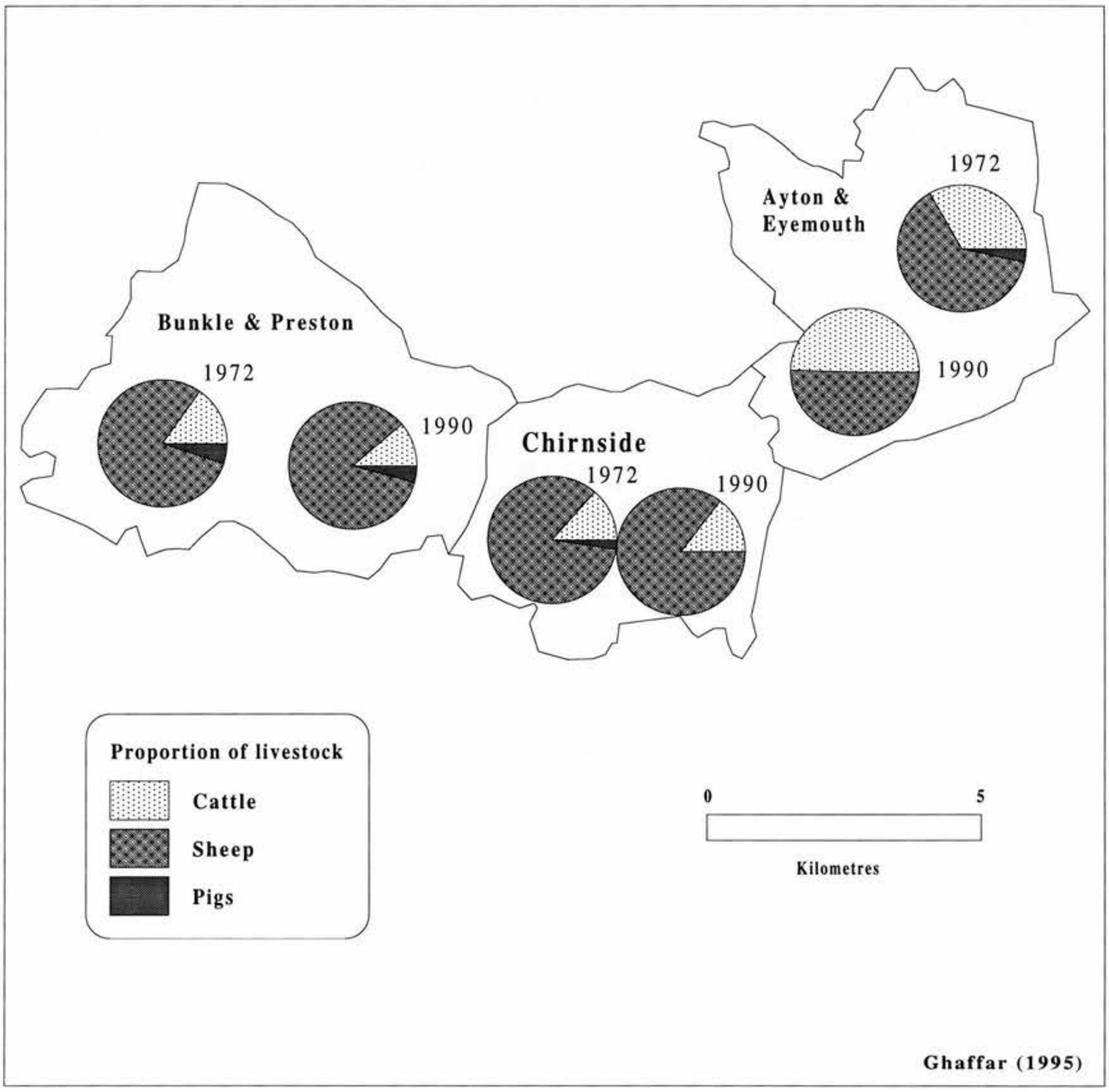


Figure 6.6 Proportional change in livestock between 1972 and 1990

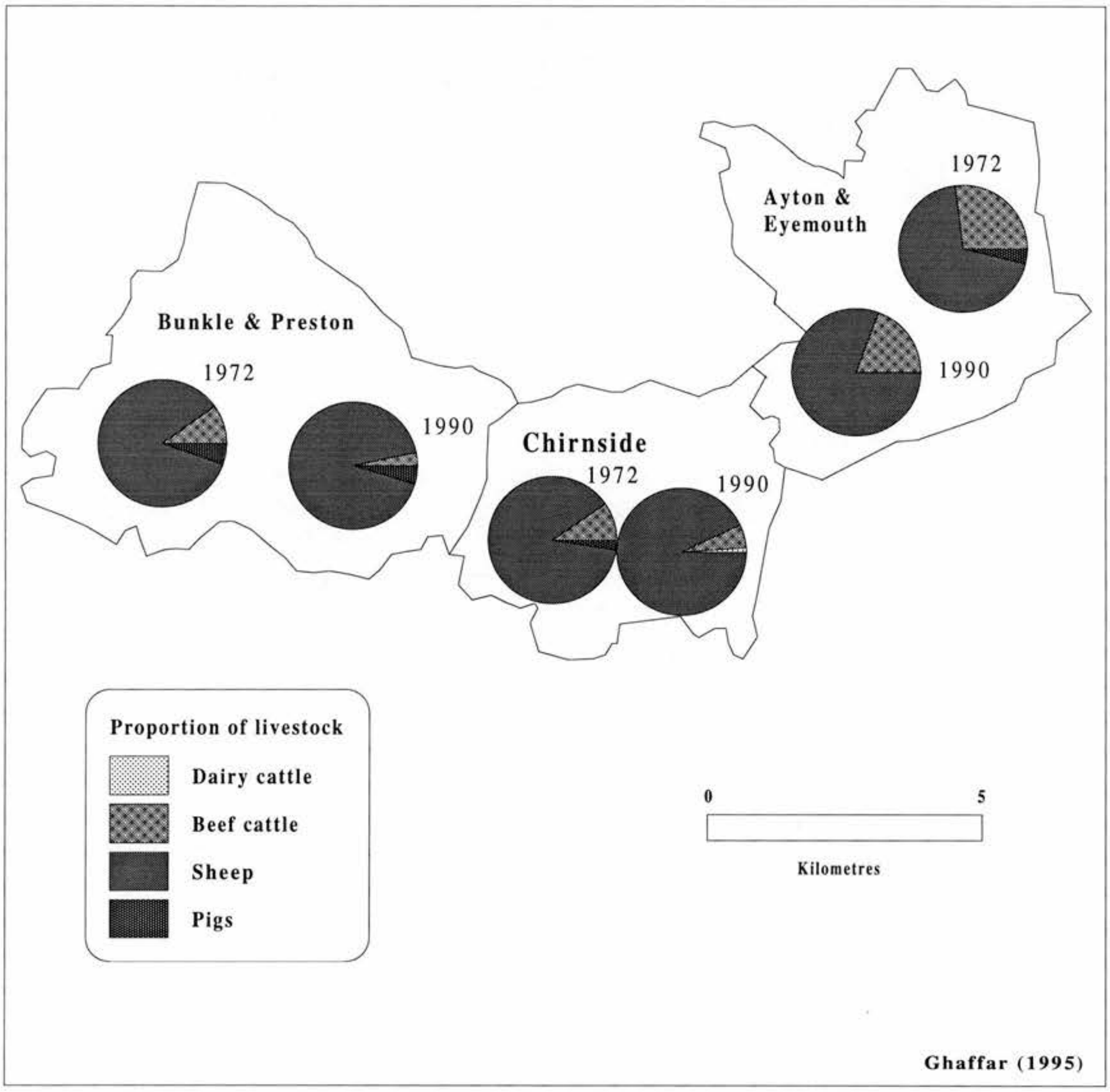


Figure 6.7 Proportional change in major livestock between 1972 and 1990

and beef cattle, sheep and pig production. Sheep production continued to dominate in this period, despite a reduction in total numbers.

Table 6.4 shows the number of livestock per 100 ha of agricultural land. In Bunkle & Preston, beef cattle, sheep and pigs increased per 100 ha of agricultural land but in other parishes they declined. Poultry also declined in all parishes. Average farm size increased in Ayton & Eyemouth but declined in other parishes between 1972 and 1990. Farm labour declined in all parishes.

These patterns of agricultural change suggest there have been major changes in the parishes. Mixed farming has long been a feature of Berwickshire agriculture. Increases in the area under tillage may point to the intensification of crop production in the area. Areas under grass and rough grazing have been converted to tillage. The area under wheat and oilseed rape has increased at the expense of other crops but does not show a major increase (Figure 6.5). The area under barley has only marginally declined because of the continuing need of barley for feeding cattle and sheep. Minor changes have also occurred in livestock production (Figure 6.6 and 6.7). Sheep production has increased at the expense of cattle, a fact largely explained by the subsidies employed: Suckler Cow Premium Scheme (1980) for beef cattle, and the Sheep Annual Premium Scheme (1980) for sheep production. According to parish summary data, there have been major changes in land use in the sample parishes during the period 1972 - 1988, mainly due to two factors: wide differences in land capability for agriculture, and changing patterns of farm type. Improvement of land for arable purposes or for changes in livestock management has led to a increase in the area under tillage and other crops.

Table 6.4 Changes in livestock, labour and farm size in sample parishes per 100 ha of agricultural land

Ayton and Eyemouth

	Dairy Cattle	Beef Cattle	Sheep	Pigs	Poultry	Labour	Average farm size*
1972	0.04	73.59	140.29	7.86	26.52	3.06	123.01
1976	0.00	83.44	223.68	24.53	1170.87	2.98	323.71
1980	1.01	88.65	99.61	0.54	5.30	2.49	154.09
1984	0.24	59.39	66.71	0.49	3.12	2.36	144.21
1988	0.00	59.57	56.56	0.00	3.59	1.83	193.05
1990	0.00	66.04	67.37	0.00	3.29	1.70	184.35

Bunckle & Preston

	Dairy Cattle	Beef Cattle	Sheep	Pigs	Poultry	Labour	Average farm size*
1972	0.03	69.95	366.89	23.43	1016.63	2.87	225.20
1976	0.00	94.82	286.14	37.66	2373.62	3.01	216.05
1980	0.00	93.49	286.89	35.37	742.42	2.68	226.61
1984	0.00	86.24	260.81	37.35	140.90	2.23	227.36
1988	0.00	60.65	331.80	25.39	1.91	1.82	223.15
1990	0.00	70.80	528.31	26.74	2.35	1.77	207.44

Chirnside

	Dairy Cattle	Beef Cattle	Sheep	Pigs	Poultry	Labour	Average farm size*
1972	0.05	57.77	357.36	10.23	15.01	2.45	183.82
1976	1.21	50.11	374.53	6.59	9.99	2.47	182.20
1980	0.05	51.52	355.10	2.60	2.49	2.27	184.96
1984	1.06	40.56	195.12	0.00	2.38	1.75	189.11
1988	4.18	26.31	218.08	0.00	1.20	1.62	212.87
1990	2.59	35.12	219.70	0.00	0.42	2.27	171.89

Source:Derived from Agricultural Returns

*** Average farm size is under agricultural land**

6.4 COMPONENTS OF LANDSCAPE CHANGE

6.4.1 Field size

The total number of fields has declined in this sample area from 578 to 502 (a 13% decrease). Table 6.5 shows changes in the total number of fields in the sample area of Berwickshire.

Table 6.5 Patterns of change in field size

Hectares	Number of fields in 1974	Number of fields in 1988	Change 1974-88	Percentage Change
0 - 4.9	127	74	-53	-41.73
5 - 9.9	227	191	-36	-15.86
10 - 14.9	143	146	3	2.10
15 - 19.9	49	47	-2	-4.08
20 - 24.9	22	27	5	22.73
>= 25	10	17	7	70.00
Total fields	**578**	**502**	**-76**	**-13.15**
Total area	**5489**	**5535**	**46**	**0.84**

Source: Rural landscape change data

On the other hand, an area of 46 ha was added to the overall extent of agricultural land through improvement of some non-agricultural land. The greatest rate of change was found for fields less than 10 ha. Figure 6.8 show the patterns of changes in field size. The highest increase had been found for fields larger than 25 ha (a 70% change). Figure 6.8 also shows the patterns of field size change within the total number of fields. Table 6.6 presents the changes in number of fields in the parishes.

Table 6.6 Field size change in parishes

	Number of fields (1974)	Number of fields (1988)	change 1974-88	% change 1974-88	Area (ha) 1974	Area (ha) 1988
Ayton & Eyemouth	290	262	-28	-9.66	2375	2405
Bunkle & Preston	132	109	-23	-17.42	1577	1586
Chirnside	156	131	-25	-16.03	1537	1544
Total	**578**	**502**	**-76**	**13.14**	**5489**	**5535**

Source: Rural landscape change data

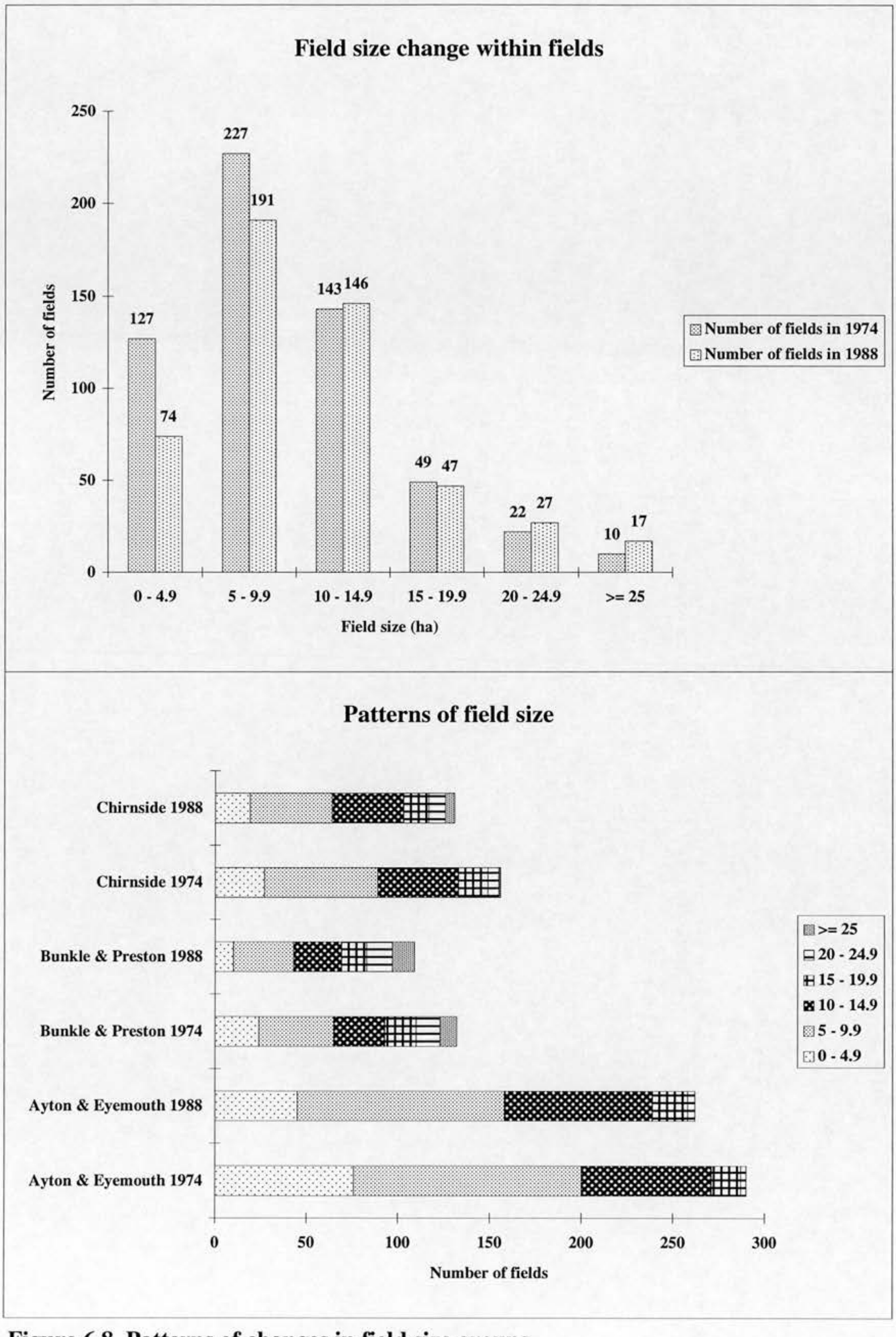


Figure 6.8 Patterns of changes in field size groups

In Ayton and Eyemouth, 28 fields were amalgamated in the period 1974 - 1988. Similar patterns are found in the other parishes. Figure 6.9 presents the changes in farm holdings in the area. Table 6.7 presents the changes in the number of fields and their area in the four parishes between 1974 and 1988.

Table 6.7 Patterns of field size change in parishes

Hectares	Ayton & Eyemouth 1974	Ayton & Eyemouth 1988	Bunkle & Preston 1974	Bunkle & Preston 1988	Chirnside 1974	Chirnside 1988
0 - 4.9	76	45	24	10	27	19
5 - 9.9	124	113	41	33	62	45
10 - 14.9	71	81	28	26	44	39
15 - 19.9	16	19	17	14	16	14
20 - 24.9	3	4	13	14	6	9
>= 25	0	0	9	12	1	5
Total	**290**	**262**	**132**	**109**	**156**	**131**

Source: Rural landscape change data

The data suggest a substantial reduction in the number of fields, with the smallest reduction in Ayton & Eyemouth parish (-9.65%). The highest reduction was in Bunkle & Preston where there was a decrease from 132 fields to 109 (-17.42 %). All 23 fields were part of field amalgamation. The same level of field reduction was found in Chirnside (a decrease from 156 fields to 131). Figure 6.9 also shows the average change in field size brought about through field amalgamation. In Ayton & Eyemouth there was an increase in average size from 8.19 ha to 9.18 ha (+ 12%). The extent of change in Bunkle & Preston and Chirnside is very high. Bunkle & Preston has the highest field size change from 11.95 ha to 21.79 ha (+21.79 %) and Chirnside from 9.85 ha to 11.79 ha (+19.62 %).

Another point to be noted is that the total area of the fields has been increased slightly, indicating that some additional land has been brought into agricultural use. Table 6.7 shows the changes in field sizes. In all parishes, the highest changes occurred amongst the smallest fields which have consistently been the main targets of field enlargement. Some large fields have been created in consequence. In 1974, there was no field greater than 40 ha in any of these four parishes; by 1988, in Bunkle & Preston, some fields up to 70 ha in extent had been created.

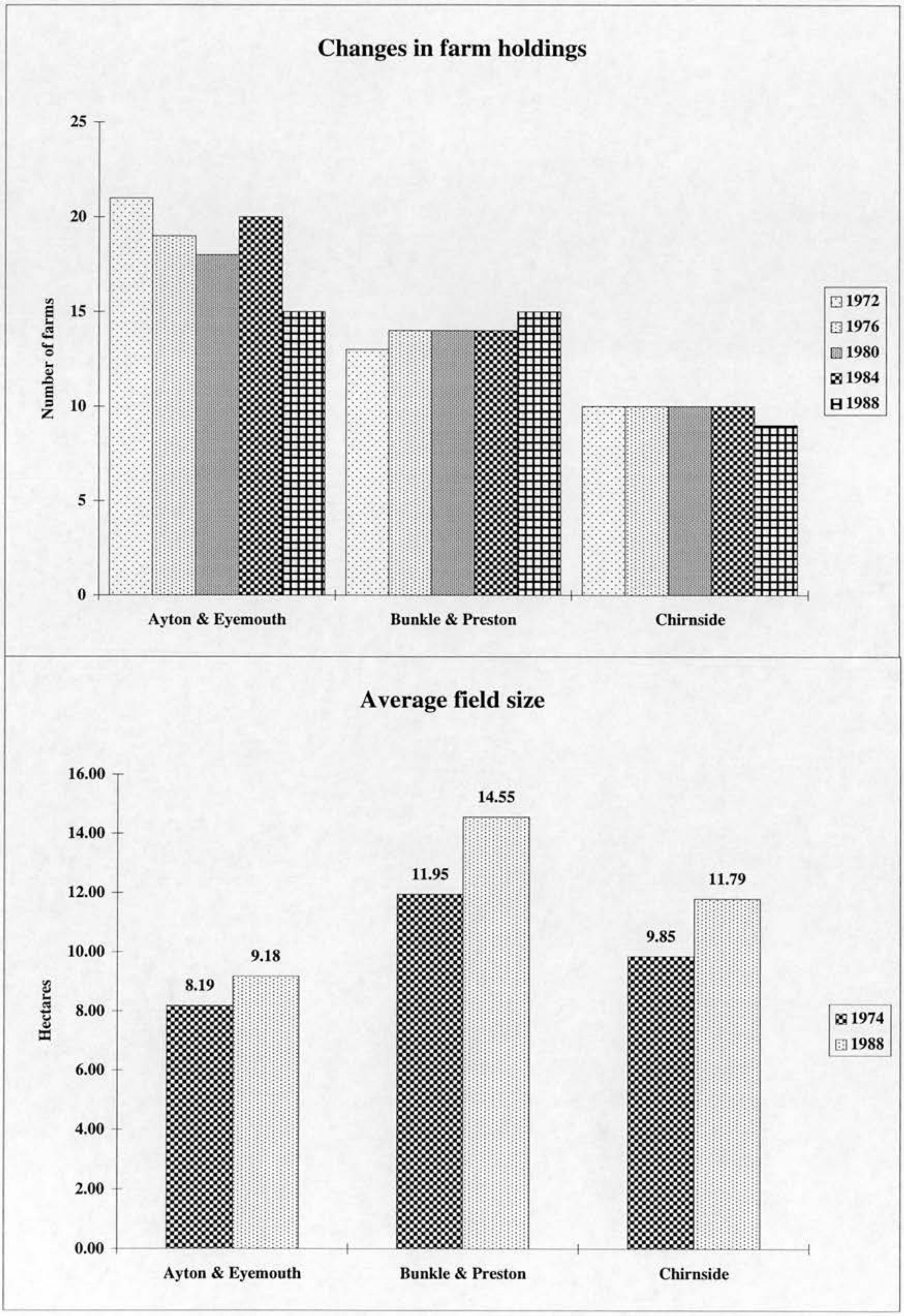


Figure 6.9 Changes in farm holdings and average field size in sample parishes

Figures 6.10 and 6.11 illustrates the spatial patterns of field size change and the trend of field amalgamation. For example, in the southern part of Bunkle & Preston, four fields were amalgamated, and three fields were amalgamated in the central part of the parish. In Chirnside, amalgamation has chiefly occurred in the eastern part where 10 fields have been amalgamated to create three large fields. In Ayton and Eyemouth, several fields under 5 ha have been amalgamated to make new fields up to 15 ha. The questionnaire survey revealed that in Ayton & Eyemouth four farms out of six amalgamated their fields compared with five out of 10 in Bunkle & Preston and two out of three in Chirnside.

Although the Berwickshire parishes did not show great change in crop production, reduction in the number of total fields (a reduction by 76 fields) suggests that farmers have enlarged their fields in order to increase productivity and that smaller fields in particular have been the main target of amalgamation (Table 6.7).

6.4.2 Field Boundaries

The removal of field boundaries and especially hedgerows has been one of the major characteristics of agricultural intensification that has been most widely criticised (CCS and the NCC, 1989; Shoard, 1980; Worcester and Herefordshire, 1985; Countryside Commission, 1984, 1987; Blunden, 1985, 1988). Table 6.8 shows the overall nature of field boundaries in the Berwickshire sample area between 1974 and 1988.

Table 6.8 Patterns of field boundaries in sample area (Kms)

	1974	**1988**	**Removed**	**Added**	**change 1974-88**	**% change 1974-88**
Hedgerows	119.96	188.62	14.46	83.12	68.65	57.23
Post & wire fences	177.09	143.64	31.78	1.66	-33.45	-18.89
Vegetative belt	79.66	88.37	2.80	11.52	8.72	10.94
Tree line	17.20	30.90	2.35	16.04	13.70	79.60
Stone walls	26.43	27.24	8.25	9.06	0.81	3.06
Dykes & others	30.49	27.26	7.19	3.96	-3.23	-10.58
Total	**450.84**	**506.04**	**66.83**	**125.36**	**55.20**	**12.24**

Source: Rural landscape change data

Figure 6.10 Spatial patterns of field size change in Ayton & Eyemouth

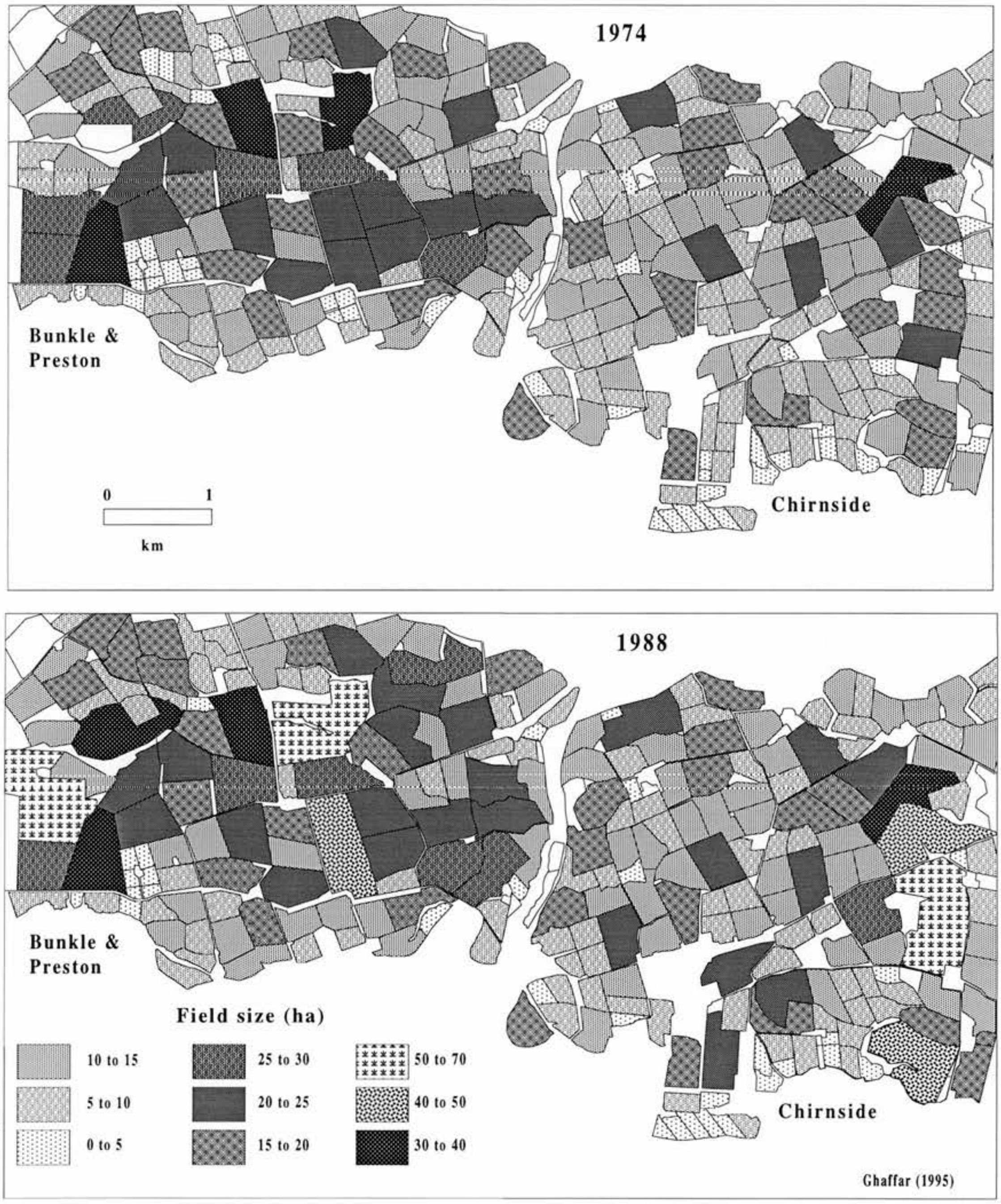


Figure 6.11 Spatial patterns of field size change in Bunkle & Preston and Chirnside

The total length of field boundaries increased from 450 kms in 1974 to 506 kms in 1988. The pattern of removal and addition of boundaries is differently apparent by boundary type. Hedgerow as a boundary type shows great change in the period. The total length of hedgerow increased from 120 kms to 188 kms (a 57% change). Post & wire fences as a boundary type lost the greatest length (-18.89%) amongst all boundary types. Tree-line boundaries also had a great change (+79.6%) in the area albeit from a low overall basis. An overall 12.24% change is found in the area. Figure 6.12 and 6.13 present these results. Table 6.9 presents the patterns of percentage change of field boundaries in relation to the total length of field boundaries.

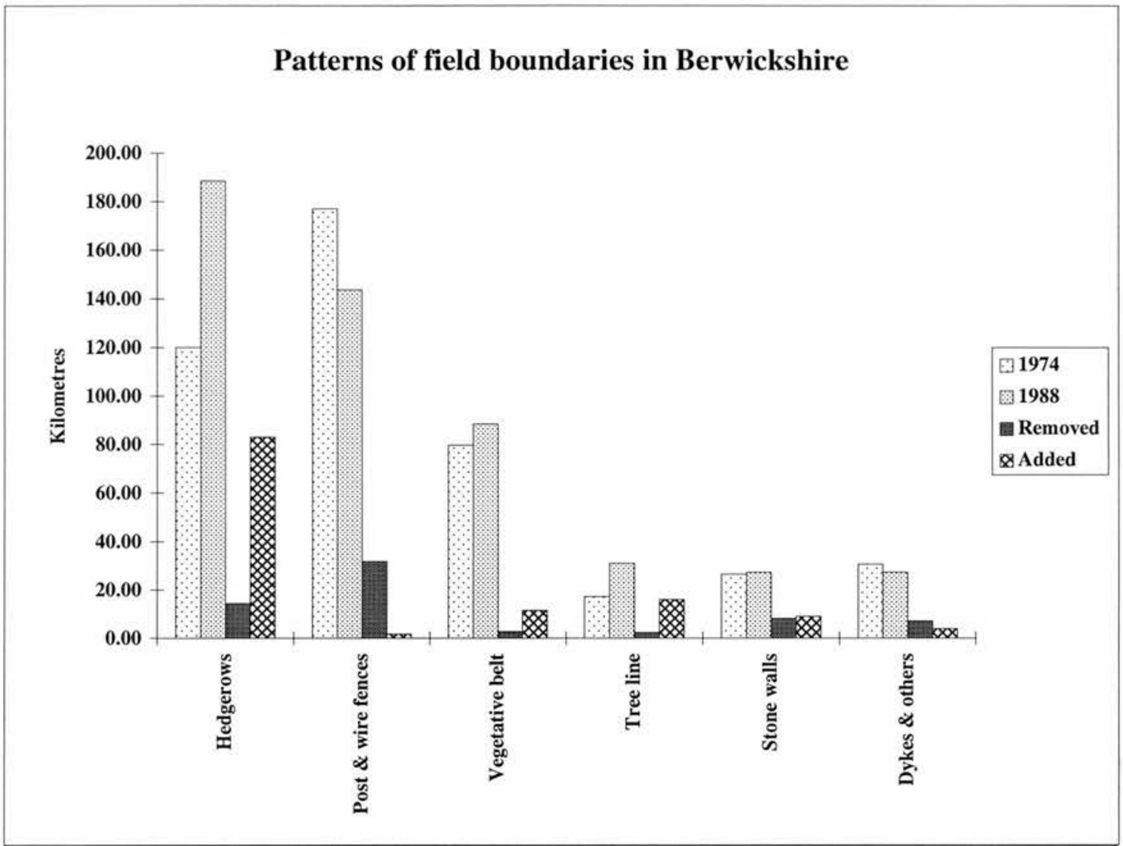
Table 6.9 Field boundaries as a percentage of all boundaries

	1974	1988	Removed	Added
Hedgerows	26.61	37.27	21.64	66.30
Post & wire fences	39.28	28.39	47.56	1.33
Vegetative belt	17.67	17.46	4.19	9.19
Tree line	3.82	6.11	3.51	12.80
Stone walls	5.86	5.38	12.35	7.23
Dykes & others	6.76	5.39	10.76	3.16

Source: Rural landscape change data

There have been changes within the total length of field boundaries. For example, hedgerows, which represented 26.6% of all boundaries in 1974, increased to 37.27% of total length by 1988. The greatest decrease occurred in post & wire fences, a decline from 39.28% to 28.39% of total length. This suggests that hedgerows, notably in their addition in this period, have a very close correlation with the removal of post & wire fences. Table 6.10 shows the patterns of field boundaries per ha of land in the sample area.

About 12 metres per ha of hedgerows were added between the period 1974 and 1988. Post & wire boundaries were removed to the extent of 6 metre per ha of land. Other boundaries had only slight change. Table 6.11 shows the percentage change of field boundaries, by types, in the sample parishes.



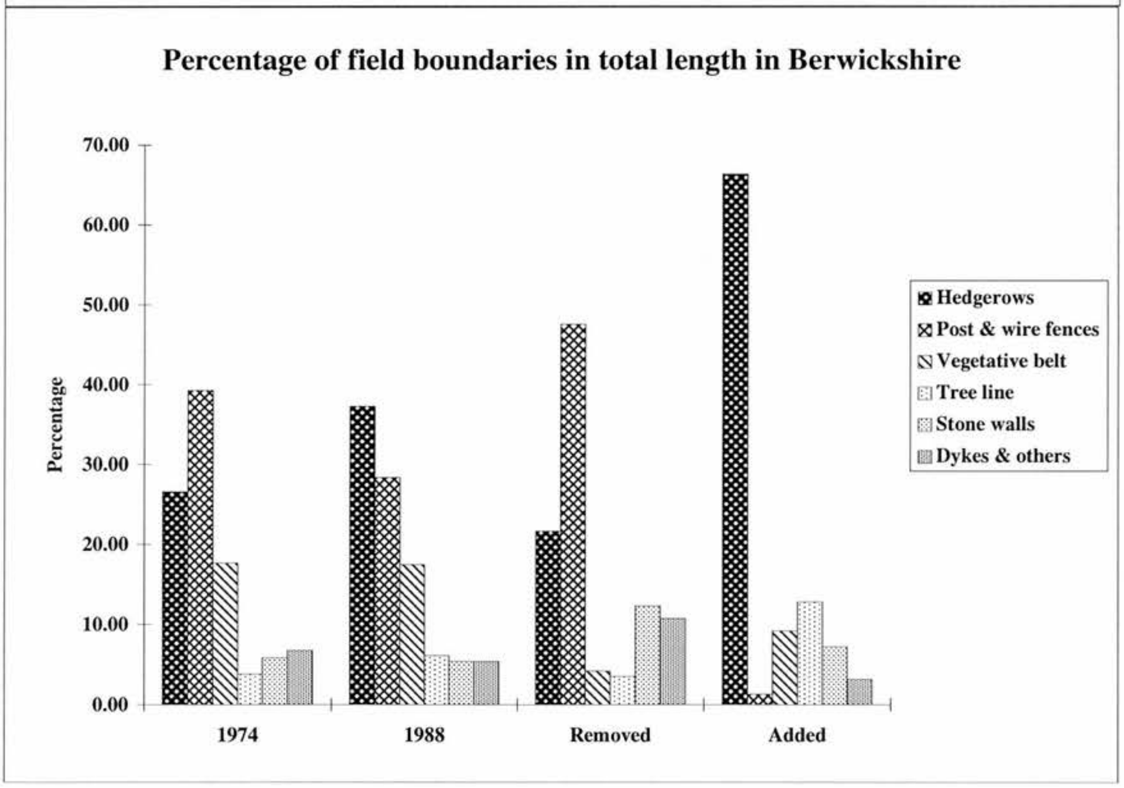
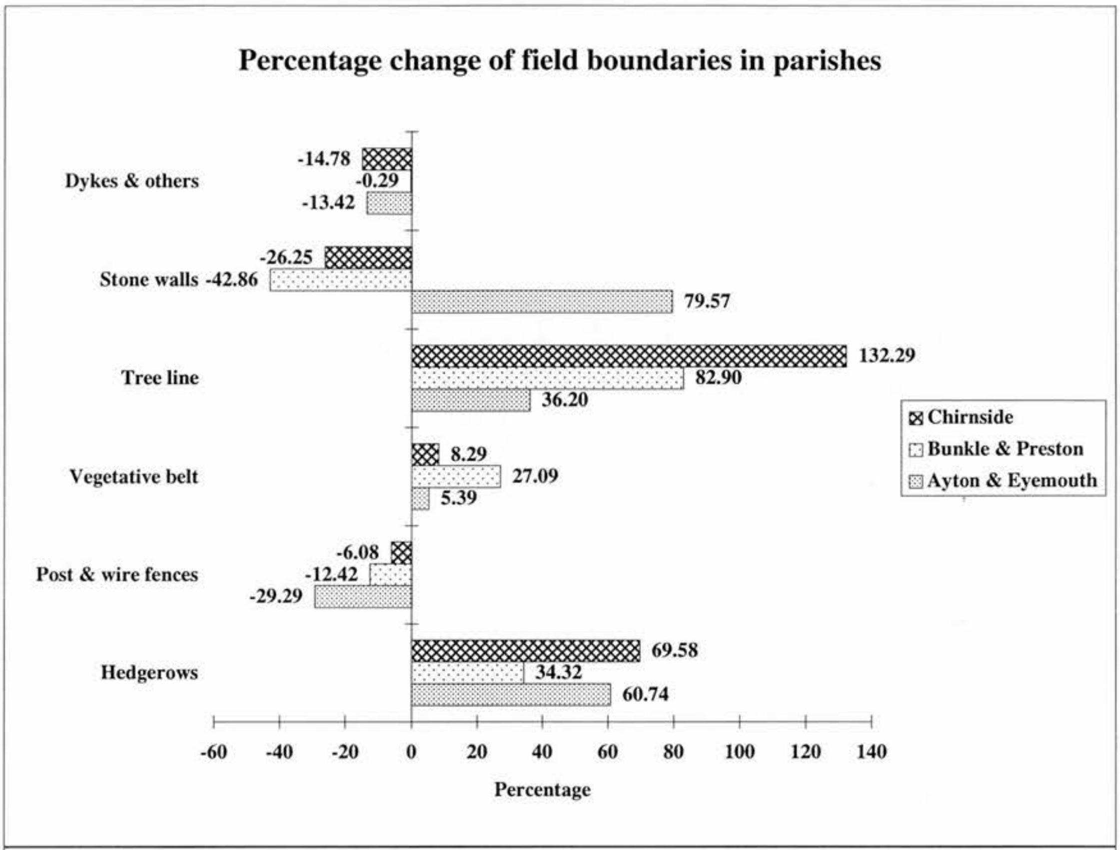


Figure 6.12 Patterns of field boundaries in Berwickshire sample area



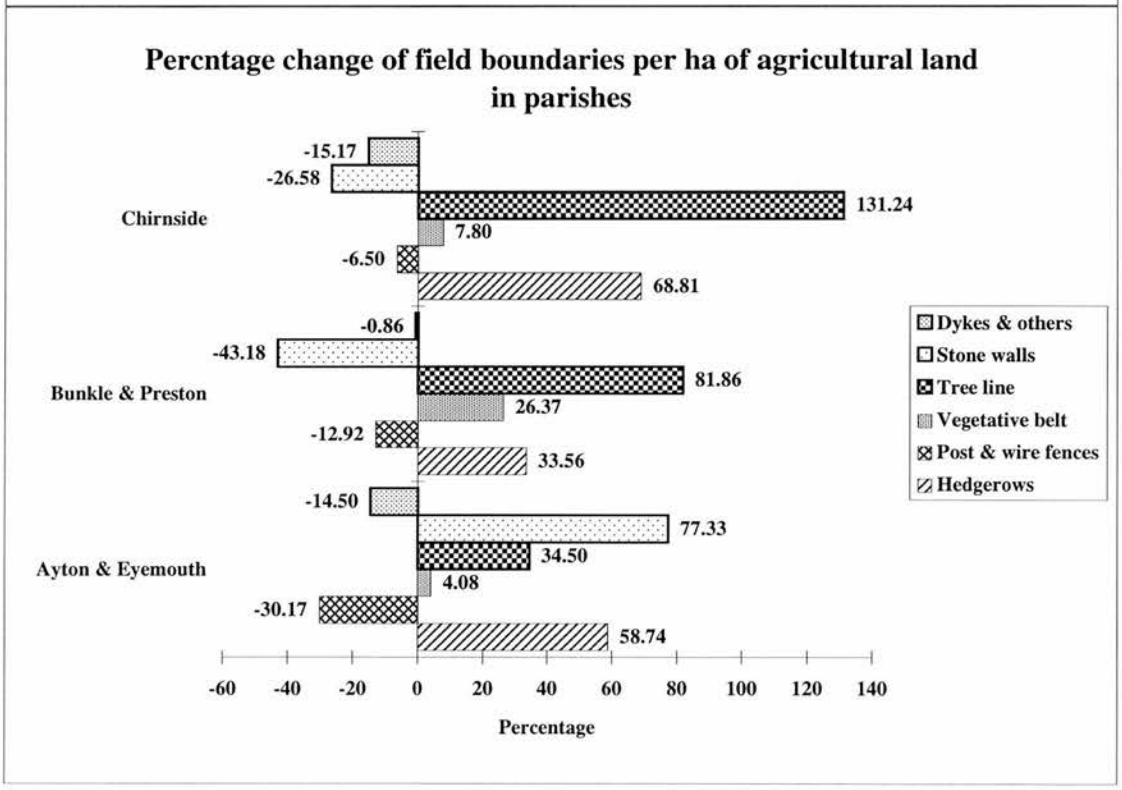


Figure 6.13 Percentage change in field boundaries in parishes

Table 6.10 Patterns of field boundaries in sample area (metres per ha)

	1974	1988	change 1974-88	% change 1974-88	Area (ha) 1974	Area (ha) 1988
Hedgerows	21.86	34.08	12.22	55.92	5489	5535
Post & wire fences	32.26	25.95	-6.31	-19.56	5489	5535
Vegetative belt	14.51	15.97	1.45	10.02	5489	5535
Tree line	3.13	5.58	2.45	78.11	5489	5535
Stone walls	4.82	4.92	0.11	2.20	5489	5535
Dykes & others	5.55	4.93	-0.63	-11.32	5489	5535
Total	**82.13**	**91.43**	**9.29**	**11.31**	**5489**	**5535**

Source: Rural landscape change data

Table 6.11 Percentage change of field boundaries by parishes (1974 - 88)

	Hedgerows	Post & wire fences	Vegetative belt	Tree line	Stone walls	Dykes & others
Ayton & Eyemouth	60.74	-29.29	5.39	36.20	79.57	-13.42
Bunkle & Preston	34.32	-12.42	27.09	82.90	-42.86	-0.29
Chirnside	69.58	-6.08	8.29	132.29	-26.25	-14.78

Source: Rural landscape change data

The net change in field boundaries 1974 to 1988 is shown in Table 6.10. In Ayton & Eyemouth all field boundaries except post & wire fences and dykes & others had a positive change. In Chirnside hedgerows increased by +69.58%, tree-lines by +132.29% and dykes & others declined by 14.78%. Bunkle & Preston had a +34.32% change in hedgerows and Ayton & Eyemouth a +60.74% change in length of hedgerows. Table 6.12 presents the percentage change of field boundaries in the sample area by metres per hectare.

Table 6.12 Percentage change of field boundaries in sample area (metres per ha)

	Ayton & Eyemouth	Bunkle & Preston	Chirnside
Hedgerows	58.74	33.56	68.81
Post & wire fences	-30.17	-12.92	-6.50
Vegetative belts	4.08	26.37	7.80
Tree lines	34.50	81.86	131.24
Stone walls	77.33	-43.18	-26.58
Dykes & others	-14.50	-0.86	-15.17

Source: Rural landscape change data

Yet, despite the evidence of field enlargement in Berwickshire and the related removal of field boundaries, the comparison of aerial photographs for 1974 and 1988 revealed an increase in the length of vegetative boundaries, especially in the length of hedgerows, and a decrease in non-vegetative boundaries and also suggested there to have been large variations between parishes. Chirnside had the highest percentage change in field boundaries like tree-lines and hedgerows but the highest change in length of hedgerows and post & wire fences occurred in Ayton & Eyemouth. Table 6.12 presents the patterns of percentages of field boundaries (metres per ha) in the parishes. Ayton & Eyemouth has -30% change in post & wire, but it has a very high rate of change under hedgerows (+58%).

A number of losses and gains of hedgerows within each parish has occurred. Table 6.13 represents the patterns of change in the parishes.

Table 6.13 Removal and addition of hedgerows (kms)

	1974	1988	Removed	Added	change 1974-88	% change 1974-88
Ayton & Eyemouth	73.084	117.477	2.106	46.499	44.393	60.74
Bunkle & Preston	23.703	31.838	5.619	13.754	8.135	34.32
Chirnside	23.176	39.302	6.737	22.863	16.126	69.58

Source: Rural landscape change data

In Ayton & Eyemouth a total length of 2.1 km was removed but 46.5 km was re-planted. The highest percentage change was in Chirnside (+69.58%) and in Ayton & Eyemouth (+60.74%). The patterns of change can be seen in Figure 6.14. New planting appeared at about 100 separate places and one third (15 km) of this new re-planting was along roads. For Bunkle & Preston 5.62 kms were removed and 13.75 km re-planted. Some hedgerow removal has occurred along roads but re-planting was much more widespread. Nearly all farms in the sample parishes have replaced post and wire fences and other boundaries with hedgerows. In Chirnside 6.74 km of hedgerow were removed and 22.86 km were re-planted, in about 50 locations. About 8 kms of hedgerows were replanted along the roadside. Figure 6.14 clearly shows that hedgerows have been removed, most probably for the enlargement of fields, and

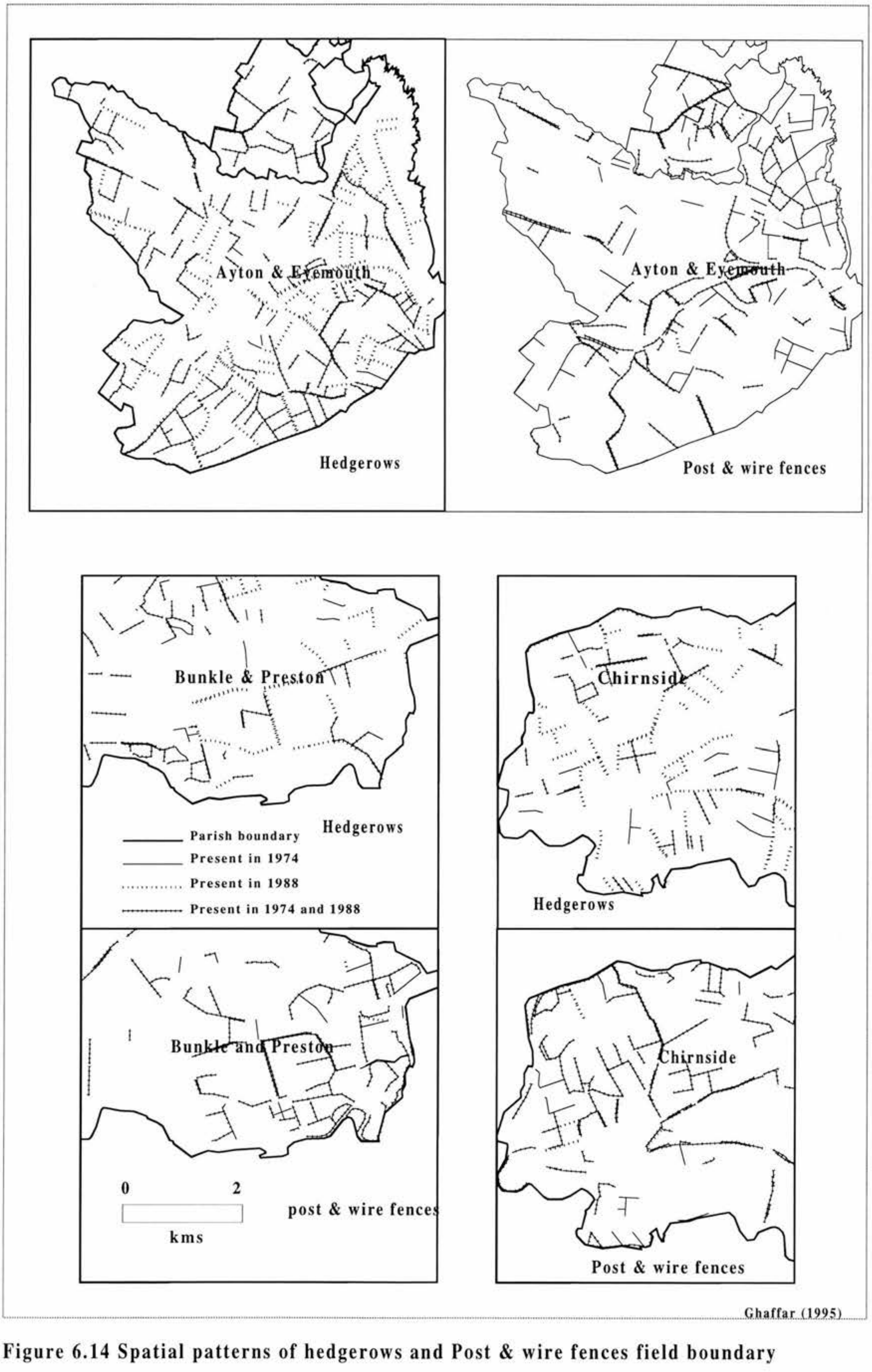


Figure 6.14 Spatial patterns of hedgerows and Post & wire fences field boundary

then replanted along the roadsides and at the expense of post and wire fences. The same pattern appears for the other parishes with re-plantation of hedgerows at the expense of other boundaries and especially post and wire fences. The evidence for the re-planting of hedgerows is extensive, surprising and contrary to that reported in those previous studies which have always been identified a negative change in hedgerows (Bowers and Cheshire 1983; Westmacott 1984; and Blunden and Curry 1985). This re-appearance of hedgerows in the study area is clearly linked to schemes to encourage farmers to re-plant hedgerows. As in East Lothian, the re-planting has been done primarily at the expense of post & wire fences because their removal is relatively easy.

As Table 6.14 suggests the highest percentage of field boundary removals in all parishes has been of post & wire fences.

Table 6.14 Removal and addition of post & wire fences (km)

	1974	1988	Removed	Added	change 1974-88	% change 1974-88
Ayton & Eyemouth	86.392	61.089	24.905	0.398	-25.303	-29.29
Bunkle & Preston	41.494	36.341	4.383	0.77	-5.153	-12.42
Chirnside	49.202	46.211	2.495	0.496	-2.991	-6.08

Source: Rural landscape change data

This field boundary has been removed not only for the enlargement of fields but has been widely replaced by new hedgerows (see Table 6.14 and Figure 6.14). The greatest losses occurred in Ayton & Eyemouth which had more than 60 separate sites of removals covering a total length of 24.9 km. In about 20 places, it was replaced by hedgerows. In spite of minimal field amalgamation and a marginal increase in the number of farm holdings, Bunkle & Preston had over 15 locations at which there was removal of this boundary, to a total length of 4.38 km. The same pattern can be seen in Chirnside. The highest percentage change (+29.29) of this boundary is in Ayton & Eyemouth.

Other vegetative field boundaries (woodland fringes, vegetative belts except hedgerows and semi-natural vegetative belts along fields) experienced the highest change after hedgerows. They increased in all parishes but removals were found only in Ayton & Eyemouth to a total length of 2.8 km. Table 6.15 represents the patterns of field boundaries change in the parishes.

Table 6.15 Removal and addition of vegetative belt (km)

	1974	1988	Removed	Added	change 1974-88	% change 1974-88
Ayton & Eyemouth	38.069	40.122	2.8	4.853	2.053	5.39
Bunkle & Preston	17.118	21.755	0	4.637	4.637	27.09
Chirnside	24.469	26.497	0	2.028	2.028	8.29

Source: Rural landscape change data

The highest increase of vegetative field boundaries was in Bunkle & Preston (27.09%). Figure 6.15 shows the patterns of this boundary type. It appeared at ten locations in Bunkle & Preston, at five in Chirnside and at seven places in Ayton and Eyemouth.

The pattern of change for tree-line boundaries can be seen in Table 6.16.

Table 6.16 Removal and addtion of tree-line (km)

	1974	1988	Removed	Added	change 1974-88	% change 1974-88
Ayton & Eyemouth	5.904	8.041	0.747	2.884	2.137	36.20
Bunkle & Preston	6.865	12.556	1.073	6.764	5.691	82.90
Chirnside	4.435	10.302	0.528	6.395	5.867	132.29

Source: Rural landscape change data

The greatest loss of this boundary type is in Bunkle & Preston where 1.07 km was removed and 6.7 km were re-planted. Chirnside has the highest gain of this boundary (+132.29%). The lowest change was in Ayton & Eyemouth (+36.20 %). The patterns revealed in Figure 6.15 shows that this type has appeared widely in all parishes.

Amongst the various field boundary types stone walls were exceptional. Table 6.17 represents the patterns of change of this type in the Berwickshire parishes.

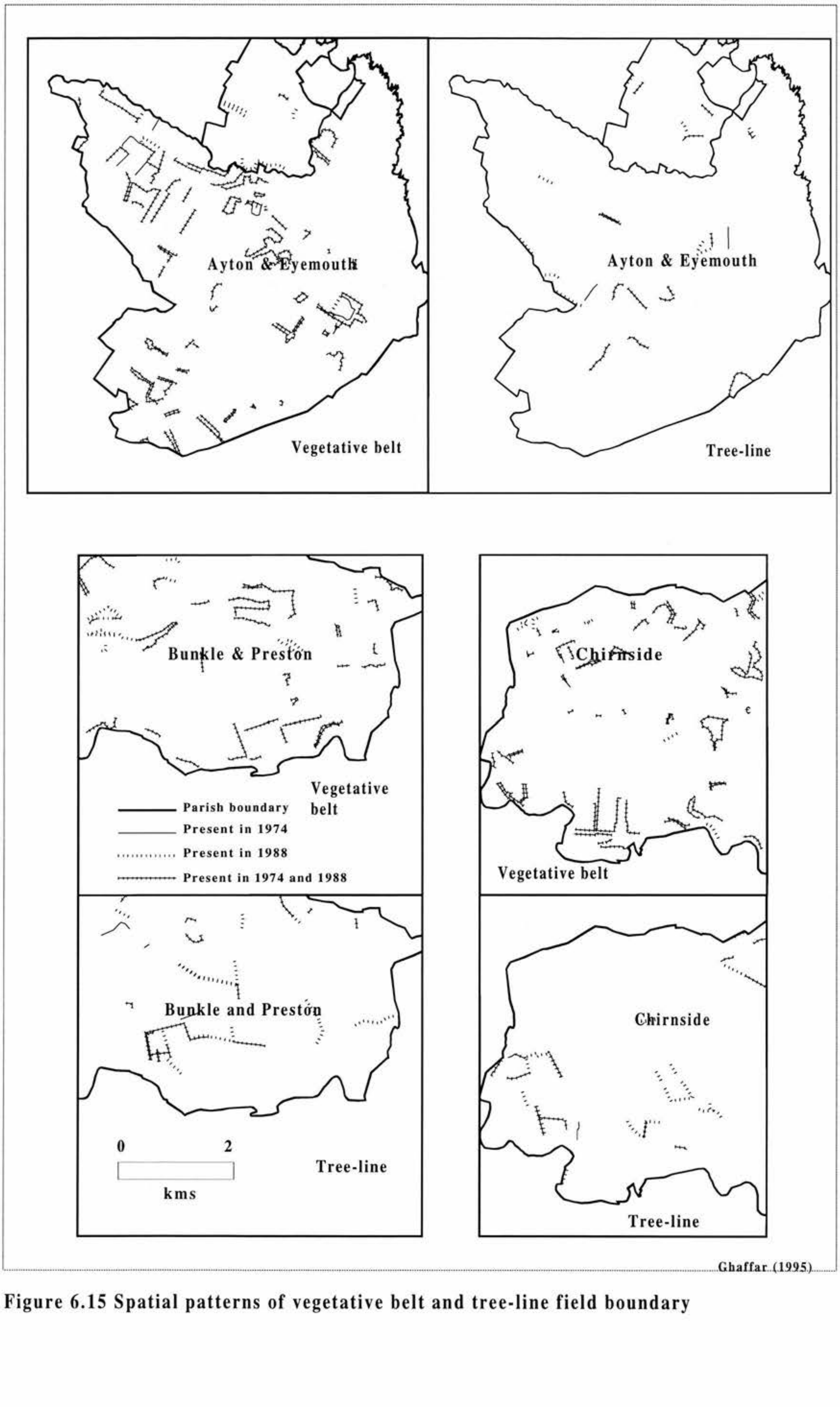


Figure 6.15 Spatial patterns of vegetative belt and tree-line field boundary

A net loss of this field boundary occurred in Bunkle & Preston (-42.86%) and in Chirnside (-26.25%). The highest change of this field boundary was in Ayton & Eyemouth (+79.57%), with new construction of 8.22 kms.

Table 6.17 Removal and addition of stone walls (km)

	1974	1988	Removed	Added	change 1974-88	% change 1974-88
Ayton & Eyemouth	9.03	16.21	1.04	8.22	7.18	79.57
Bunkle & Preston	10.867	6.21	4.66	0.00	-4.65	-42.86
Chirnside	6.54	4.82	2.54	0.83	-1.71	-26.25

Source: Rural landscape change data

This creation of stone walls (see Figure 6.16) appeared in that part of the parish which was unsuitable for arable farming due to soil conditions, and is largely associated with intensification of livestock. In parishes suitable for arable farming, there was only a minor addition to the extent of this boundary.

Miscellaneous field boundaries include ditches and earth banks, hill slopes and boundaries not recognised during photo interpretation. Several of these have been removed for field enlargement and have been replaced by re-planting of hedgerows. Table 6.18 presents the change in dykes and other boundary types.

Table 6.18 Removal and addition of dykes & others (km)

	1974	1988	Removed	Added	change 1974-88	% change 1974-88
Ayton & Eyemouth	13.65	11.82	4.08	2.19	-1.83	-13.42
Bunkle & Preston	7.56	7.54	1.74	1.76	-0.02	-0.29
Chirnside	9.28	7.91	1.37	0.0	-1.37	-14.78

Source: Rural landscape change data

Some additions occurred in Ayton & Eyemouth and in Bunkle & Preston where new ditches were laid to improve drainage (see Figure 6.16). In Bunkle & Preston, the rates of removal and addition were the same. The highest change in this boundary was in Ayton & Eyemouth where 4.08 kms were removed and 2.19 kms added.

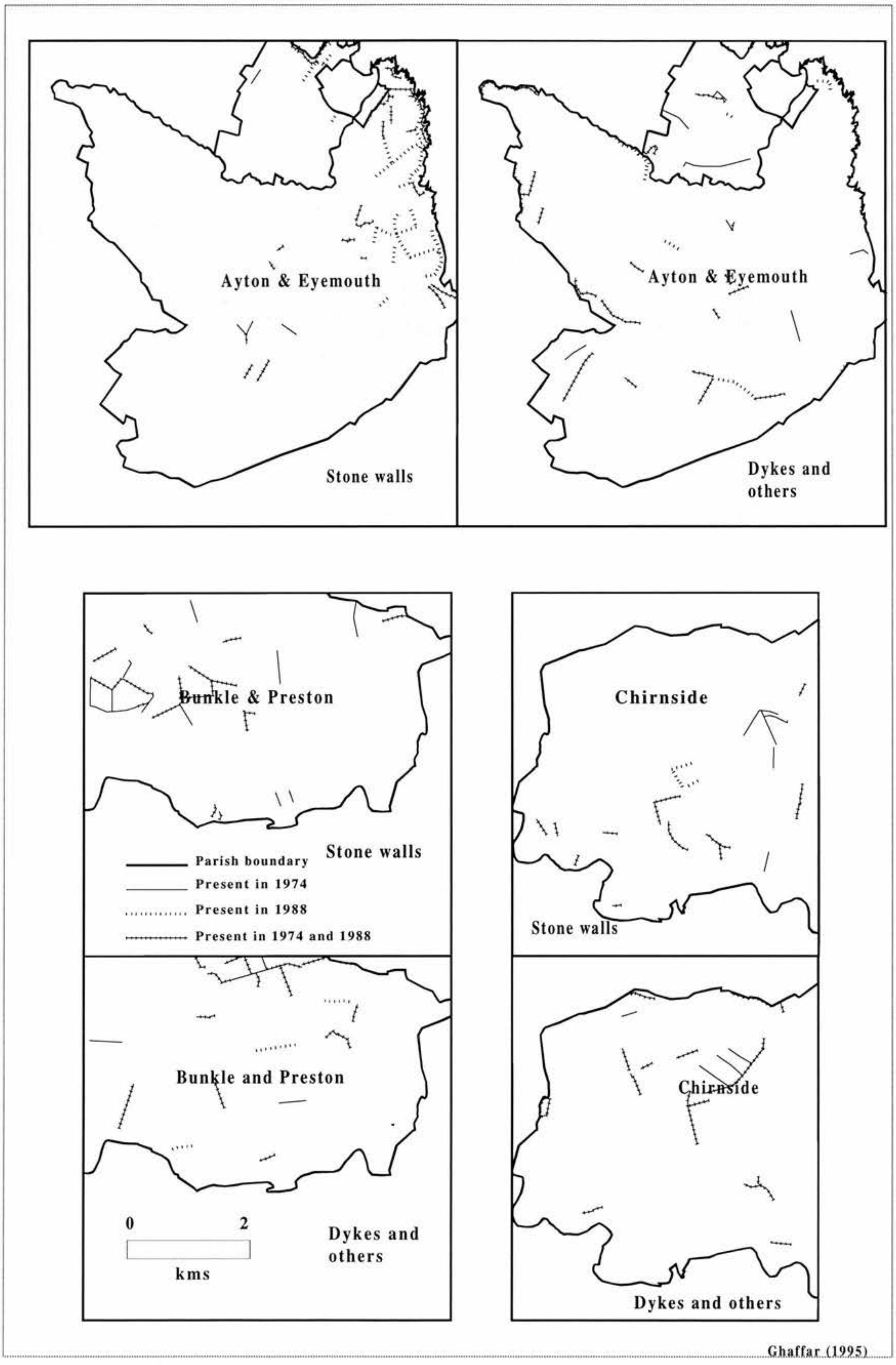


Figure 6.16 Spatial patterns of stone walls and dykes and others field boundary

The pattern of removal of field boundaries in the Berwickshire sample area suggests that farmers have been changing their field boundaries in order to enlarge the fields, either within the present farm area or by adding additional area to their farms. Capital grant schemes and other subsidies have encouraged the farmers here, as elsewhere, to change their farm's extent and structure. Hedgerows and post & wire boundaries have been the main focus of change as capital grant schemes have been offered for the development of farms. The highest removal has been of post & wire fences and hedgerows for purposes of field amalgamation. Removal of field boundaries in conjunction with pasture has been much more limited. According to questionnaire evidence, farmers who have removed their field boundaries have participated in the Farm and Horticulture Development Scheme (1976-1980), the Agricultural Improvement Scheme (1980-1985), the Agricultural and Horticultural Grant Scheme (1980-1985), the Farm and Conservation Grant Scheme (1989-1993), and the Agricultural and Horticultural Development Scheme (AHDS).

6.4.3 Removal of farm features

Various farm features have been removed. It was very hard to identify some of these features through aerial photographs so questionnaire survey data were used to investigate the changes. Farm features selected for this purpose were ponds and wells, dispersed trees, and farm buildings. There has been little change of these farm features in the study area. Most change has occurred in Ayton and Eyemouth, where three farms removed hedgerows, four farms removed post & wire fences and two farms removed farm buildings. In Bunkle & Preston five farms removed dispersed trees. The removal of farm features is particularly associated with addition of new land which has not been a major factor in the area. Westmacott (1984) noted that removal of farm features has been relatively minor in comparison with the removal of field boundaries. Shoard (1980, 1987), Blunden (1985, 1988) and others have also identified the importance of change in the field boundaries rather than in other farm features.

6.4.4 Woodland and semi-natural vegetation

The deterioration of farm woodland has been particularly critical as one result of agricultural intensification as farmers' time becomes diverted to other more profitable agricultural enterprises (Essex, 1987; CCS and NCC, 1989), although some studies have identified a higher rate for the plantation of woodland (MLURI, 1992). The area under woodland in the sample area is mainly more than 70 metres above sea level. Ayton & Eyemouth have about 50% of the total wooded area in the sample area. That area of Bunkle & Preston which is not part of the sample area but adjacent to Ayton & Eyemouth is densely wooded. There has been some woodland removal in Ayton & Eyemouth and this land has been either converted to arable land or replanted but in the latter context did not appear in the aerial photographs. There has been some increase in the area under woodland mainly through new planting of coniferous woodland. Most removal has been of mixed woodland. Table 6.20 represents the patterns of removal and re-plantation of woodland in the area between 1974 and 1988. The total area of woodland in the sample area fell from 429 ha to 420 ha. Ayton & Eyemouth had a 7% decrease. In other parishes the area under woodland increased although there is pattern of removal and plantation of woodland within the sample parishes. Coniferous woodland has the highest amount of removal (-13.6%) in Ayton & Eyemouth. Bunkle & Preston (20%) and Chirnside (14%) have additions. The area under non-coniferous woodland fell in Bunkle & Preston (-60%) but has risen (12.5%) in Ayton & Eyemouth and (14.3%) in Chirnside. Mixed woodland has the highest decrease (-8.7%) in Ayton & Eyemouth and (-17.6%) in Chirnside. The questionnaire survey revealed that farmers had been widely adopting woodland schemes offered by the government.

Some areas of semi-natural vegetation were improved and utilised for arable purposes between 1974 and 1988. The total area under semi-natural vegetation in the sample area in 1974 was 53 ha, of which about 40 ha (75%) was converted to arable by 1988. The total area in Bunkle & Preston and Ayton & Eyemouth was about 20 ha and all of this was improved for arable. In Chirnside, 32 ha area was under semi-natural vegetation, of which 19 ha (60%) was converted to arable.

6.5 FARMERS' RESPONSES TOWARDS AGRICULTURE, RURAL LANDSCAPE AND THE CAP

Eighteen farmers from the sample parishes responded to the questionnaire survey. On the basis of farmers' responses, the data were categorized into seven farm types (Table 6.19). Four of them are arable and dominantly arable with some livestock, two are intensively sheep and stock (cattle, sheep and pigs), six are arable/beef and three stock/arable.

Table 6.19 Farm types and their principal characteristics in Berwickshire

Type of farm	Arable	Arable/ beef	Arable/ sheep	Arable/ stock	Sheep	Stock	Stock/ arable	Total
Number of farms	2	6	1	4	1	1	3	**18**
Area (hactares)	354	1919.6	245	2932.7	178	22	858	**6509.3**
No. of parcels	21	55	1	45	3	1	39	**165**
Tenure								**0**
Wholy owned	1	5	1	3	1	1	2	**14**
Wholy rented	0	1	0	0	0	0	0	**1**
Part owned/rented	1	0	0	1	0	0	1	**3**
Status of farm								**0**
Full time	2	6	1	4	1	0	2	**16**
Part time	0	0	0	0	0	1	1	**2**
Farm business								**0**
Family	2	6	1	2	1	1	3	**16**
Family/Corporate	0	0	0	2	0	0	0	**2**
								0
Total permanent Labour								**0**
Male	4	24	2	26	1	2	10	**69**
Female	0	4	0	0	1	1	5	**11**
a. Family members								**0**
Male	4	10	2	9	1	1	4	**31**
Female	0	2	0	0	0	1	3	**6**
b. Others								**0**
Male	0	14	0	17	0	1	6	**38**
Female	0	0	0	0	0	0	2	**2**
c. Full time (inc. a & b)								**0**
Male	4	22	2	26	1	2	10	**67**
Female	0	1	0	0	0	1	0	**2**
d. part time (inc. a & b)								**0**
Male	0	2	0	0	0	0	0	**2**
Female	0	2	0	0	1	0	5	**8**

Source: Questionnaire survey data

The total area of these 18 farms is 6509 ha. The largest area (2933 ha) is under the arable/stock farm type (4 of 18 farms). The arable/beef farm type has the highest number of farms (six) covering 1919.6 ha. A total of 14 farms is wholly owned by farmers, one is wholly rented and 3 are part owned/rented by the farmers. Almost all of the farms (16) are full-time family businesses. The total number of farm labour on these 18 farms is 69 males and 11 females. The highest numbers of farm labour are in arable/beef (24) and in arable/stock (26). The proportion of non-family members is higher than family members. Almost all male labour (67) works on a full-time basis. Table 6.19 clearly describes the nature of agriculture in the sample parishes. Almost all of the farms are mixed arable type with some stock production, a pattern different from the intensive arable East Lothian sample area.

Table 6.20 shows the nature of the intensification of agriculture by the farmers. Field amalgamation has been carried out by 10 farmers in the parishes, principally on arable and mixed arable farms.

Table 6.20 Intensification of agriculture by farmers (No. of farms)

Type of farm	Arable	Arable /beef	Arable /sheep	Arable /stock	Sheep	Stock	Stock/ arable	Total
Area increased by farms								
Increase	2	2	1	1	0	0	1	**7**
Decrease	0	0	0	0	1	0	0	**1**
No change	0	4	0	3	0	1	2	**10**
Field amalgamation	1	4	0	3	0	0	2	**10**
Increased field drainage	2	5	0	4	1	0	2	**14**
Intensification of crop production	1	4	1	3	0	0	3	**12**
Intensification of livestock production	2	1	1	2	1	0	3	**10**
Decrese in crop production	0	1	0	0	1	0	0	**2**
Decrease in livestock production	0	1	0	1	0	0	0	**2**
Intensification of crop since 1973								
Wheat	0	4	1	3	0	0	3	**11**
Barley	1	0	1	1	0	0	1	**4**
Oil seed rape	0	2	1	2	0	0	0	**5**
Potatoes	0	0	1	1	0	0	0	**2**
Intensification of livestock since 1973								
Beef cattle	1	1	0	1	0	0	1	**4**
Pig	1	0	0	0	0	0	0	**1**
Sheep	0	0	1	1	1	0	3	**6**

Source: Questionnaire survey data

Increased field drainage, necessary to improve farm productivity, was carried out by 14 farmers on almost all types of farms but especially on arable (2), arable/beef (4 out of 5), arable/stock (2) and stock/arable (2 out of 3). Intensification of crop production has been the main activity on nearly all farms: in arable (1), arable/beef (4) and stock/arable (3). The same farms have also participated in field amalgamation and increased field drainage. Wheat production has been the main target of crop intensification: 11 farmers have intensified wheat production since 1973. The production of barley and oilseed rape has also been intensified. Some farmers (7) increased their farm area, a practice which was both cause and effect of field amalgamation and agricultural intensification. Only two farms reduced crop production but they have intensified livestock production. On the other hand, ten farms intensified livestock production. Sheep and beef cattle were the main target of intensification: six farmers intensified sheep production and four intensified beef cattle on stock/arable and arable/stock farms. Only two farms decreased their livestock production whilst increasing crop production.

Table 6.20 suggests that farmers have been involved in the intensification of crop production despite the mixed type of farming and that intensification has been carried out to increase the area under tillage, especially wheat and oilseed rape, through field amalgamation in the sample area. This has chiefly affected hedgerows and post & wire fences.

Table 6.21 shows the pattern of landscape features in the parishes in 1993. Hedgerows are present on 15 farms, stone walls on 11 farms and post & wire fences on 17 farms. Only five farms had tree-line and mixed field boundaries. Farm buildings without residence are present on seven farms. Dispersed trees were present on 11 farms and ponds/well are present on nine farms. Most of these farm features are on arable/beef and stock/arable farms. Field amalgamation has been a major activity, carried out by 10 farmers mainly on arable/beef and arable/stock farms.

Table 6.21 The pattern of rural landscape features (No. of farms)

Type of farm	Arable	Arable/ beef	Arable /sheep	Arable /stock	Sheep	Stock	Stock/ arable	Total
Field amalgamation	1	4	0	3	0	0	2	**10**
Hedgerows	2	5	1	4	0	1	2	**15**
Stone walls	0	3	1	3	1	0	3	**11**
Post and wire	2	6	1	4	1	0	3	**17**
Tree line	0	0	0	2	0	0	1	**3**
Mixed	0	2	0	2	0	0	1	**5**
Hedgerows removed	0	2	0	2	0	0	1	**5**
Stone walls removed	0	0	0	1	0	0	0	**1**
Post and wire removed	1	2	0	2	0	0	3	**8**
Tree line removed	0	0	0	1	0	0	1	**2**
Mixed boundary removed	0	0	0	0	0	0	1	**1**
Farm building with Res.	0	0	0	1	0	1	0	**2**
Farm building without Res.	1	2	0	1	0	0	3	**7**
Dispersed trees	0	4	1	3	0	0	3	**11**
Pond / Well	1	3	1	2	0	0	2	**9**
Farm building without Res. removed	0	1	0	1	0	0	1	**3**
Dispersed trees removed	0	2	0	2	0	0	2	**6**
Pond / Well removed	0	0	1	1	0	0	0	**2**

Source: Questionnaire survey data

Hedgerows have been removed on five farms and post & wire boundaries have been removed on eight farms while removal of other boundaries has been minimal. Arable/beef, arable/stock and stock/arable farms are the main type of farms that have participated in the removal of these boundaries in order either to enlarge the field size or to re-plant new hedgerows. Some farm features have also been removed as part of increasing farm and field sizes. Farm buildings with residence have been removed on three farms, dispersed trees removed on six farms and ponds/wells removed on two farms. The highest removal has occurred on arable/stock farms. The area of farms has increased on seven farms: while only one farm decreased its area.

Although only 18 farmers responded to the questionnaire survey for the Berwickshire parishes, the data gained provides clear evidence of change in field boundaries and in other farm features. Field amalgamation has been carried out by more than half of the farmers. About one-third of all farmers were involved in the removal of hedgerows and post & wire boundaries from 1973. About one-half of all farmers participated in the capital grant schemes which have been offered, initially, to develop the farm for improving field drainage, buying farm machinery and capital inputs, and later for the improvement of environment and landscape of the farm.

Table 6.22 shows farmers' responses towards the CAP. Capital grants schemes - notably the Farm Woodland Scheme and the Set Aside Acheme (1988) - have been the main focus of farmers' participation. The highest participation has occurred with respect to the Farm Woodland Scheme where 11 farmers participated mainly from arable/beef and arable/sheep farms. Capital grants schemes (AHDS, FHDS, F & CGS) have been participated in by nine farmers mainly by arable/beef (5) and arable/stock (3) farmers. The Set Aside Scheme (1988) was participated in by only six farmers mostly from arable/stock (2) and stock/arable (2) farms. Only two farmers participated in the Farm Extensification Scheme.

Table 6.22 shows farmers' responses towards the CAP. In 1973, only four farmers regarded the CAP as 'bad' while five farmers regarded it as 'good'. The other nine farmers were neutral. Since 1988 the change in price support policy has been mostly disliked. Seven farmers regarded this change as 'bad', only four considered it as 'good' while six farmers remained 'neutral'. A great majority (10) of farmers were against the Set Aside Scheme but, on the other hand, 11 farmers participated in this scheme. Even after the change in price support policy, farmers regarded the Set Aside Scheme as better than continuing inefficient agricultural activity on their farms. Most farmers were neutral about the Farm Diversification Scheme and the Farm Extensification Scheme.

Table 6.22 describes the pattern of farmers' responses towards adopting the different CAP policies. Only three schemes have been favoured by the farmers. The Farm Woodland Scheme has been favoured because of the soil: farmers converted their land to woodland where production of cereals was not economic. The Set Aside Scheme has been adopted by the farmers who found this scheme better than uneconomic agricultural production, especially after the change in price support policies. Even so, many farmers have been either neutral or undecided about the CAP and its policies but among many others change in the price support policies has been disliked.

Table 6.22 Farmers' responses towards the CAP

Type of farm	Arable	Arable /beef	Arable /sheep	Arable/ stock	Sheep	Stock	Stock/ arable	Total Farms
The 1973 Farm Amalgamation Scheme	0	0	0	0	0	0	0	**0**
FHDS, AHDS, or F & CGS Schemes	0	5	0	3	0	0	1	**9**
Pig Subsidy Scheme	0	0	0	0	0	0	0	**0**
The Farm Woodland Scheme	1	4	0	3	1	0	2	**11**
Set Aside Scheme (introduced 1988)	1	1	0	2	0	0	2	**6**
The Farm Diversification Scheme	0	0	0	0	0	0	0	**0**
The Rural Enterprise Programme	0	0	0	0	0	0	0	**0**
The Farm Extensification Scheme	0	0	0	1	0	1	0	**2**
First impression about CAP								**0**
Bad	1	0	0	0	1	0	2	**4**
Good	0	3	1	0	0	0	1	**5**
Neutral	1	3	0	4	0	0	0	**8**
No view	0	0	0	0	0	0	0	**0**
Change of price support policies								**0**
Bad	1	1	0	1	1	1	2	**7**
Good	0	2	1	0	0	0	1	**4**
Neutral	1	3	0	2	0	0	0	**6**
No view	0	0	0	1	0	0	0	**1**
Set Aside Scheme (introduced 1988)								**0**
Bad	0	4	0	2	1	1	2	**10**
Good	1	1	0	1	0	0	0	**3**
Neutral	1	1	0	1	0	0	1	**4**
No view	0	0	1	0	0	0	0	**1**
The Farm Diversification Scheme								**0**
Bad	0	0	0	1	1	1	0	**3**
Good	1	2	0	1	0	0	0	**4**
Neutral	1	3	0	2	0	0	2	**8**
No view	0	1	1	0	0	0	1	**3**
The Farm Extensification Scheme								0
Bad	0	0	0	0	1	1	0	**2**
Good	0	3	0	0	0	0	0	**3**
Neutral	1	2	0	4	0	0	2	**9**
No view	1	1	1	0	0	0	1	**4**

Source: Questionnaire survey data

6.6 ANALYSIS OF RESULTS

Results of agricultural change and rural landscape change have been presented in this chapter. This section will examine the factors lying behind agricultural and landscape change and discuss them separately.

6.6.1 Agricultural change

The purpose of examining agricultural change was to assess the extent of change in each of the sample parishes, as representative of the pattern as characteristic of the Southern Uplands in Berwickshire. But, as the analysis suggests, major changes have occurred in the parishes and so the nature of the agricultural changes are outlined here and discussed briefly. The principal factors can be summarised as follow:

1. Agricultural intensification has affected land tenure;
2. Economic incentives have influenced the area both under tillage and rough grazing;
3. Higher prices for wheat and oilseed rape have modified cropping patterns;
4. Cattle and sheep production has been maintained as a principal activity;
5. Physical factors have affected the extent of agricultural change in the area;
6. The availability of capital grants and other schemes has influenced the nature of the agricultural patterns;

Historically, as a consequence of both the physical and economic environment (access to market and infrastructure), the parishes in Berwickshire have concentrated upon cereals as well as beef cattle and sheep production. The major findings which are summarised here refer to data presented in the Tables 6.1 to 6.4 and Figures 6.4 to 6.7. The results suggest that the intensification of crops has appeared through changes in farm holdings and cropping patterns. The factors lying behind these changes are structural reforms in agriculture (the Farm Amalgamation Scheme 1973 and Payments to Outgoers 1976) and the price support system under the CAP (higher prices for wheat and oilseed rape). However, variations between parishes in the case study are due in the main, to differences in physical characteristics. For example, the area under grass not for mowing, has always been higher in Bunkle & Preston than other parishes because of its topography. Wheat production has increased, most probably replacing oats and potatoes. It is also possible that the area under rough grazing and grass may have been converted to produced barley and potatoes, and the areas under oats and potatoes converted to wheat and oilseed rape as suggested by Bowler (1985, 1992) and Robinson (1988, 1994) as a result of the Capital Grant Schemes for improvements in farm structure (improving the field drainage system and purchase of expensive machinery). All these interrelated patterns suggest that physical factors as well as economic incentives have influenced the agricultural change in the area. These agricultural patterns are further supported by the farmers' responses to the questionnaire survey, where 66% of farmers intensified their crop production and 55% intensified their livestock production (Table 6.15). Moreover intensification is evident from the responses of individual farmers in wheat, beef cattle, oilseed rape and sheep production. Both crop and livestock production are major elements of their agriculture.

6.6.2 The rural landscape change

The major findings of rural landscape change in the Berwickshire study area can now be presented. They are:

1. There has been a high degree of field amalgamation in the parishes;
2. Physical characteristics (soils, topography and climate) have been the main determinants in field amalgamation;
3. Changes in land tenure have affected the patterns of field amalgamations;
4. Intensification of crops and changes in cropping patterns are the most important factors in the process of field amalgamation;
5. The availability of capital for farm improvement has also contributed to field amalgamation;
6. Hedgerows removal is associated with field amalgamation;
7. Post & wire fences have also been depleted as a result of field amalgamation;
8. There has been some replacement of post & wire fences by hedgerows;
9. Re-planting of hedgerows is more commonly located alongside roads;

10. There has been less removal of other boundary types;
11. Paradoxically, there has also been an increase of stone wall, tree line and vegetative belt boundaries;
12. Removal of some farm features and decrease in the area under woodland and semi-natural vegetation.

These major findings on rural landscape change can be examined in three groups: field amalgamations, change in field boundaries and traditional farm features.

The first five major findings come under field amalgamations. Field amalgamation is the most important aspect of rural landscape change because of its relation with agricultural change and change in field boundaries. The pattern and nature of field amalgamation has been illustrated in Tables 6.5 to 6.7 and Figures 6.8 to 6.11. A large number of fields (76) are amalgamated in the parishes (Table 6.6). The difference in number of field amalgamations between parishes is not significant (Table 6.7) which reflects the fact that amalgamation has been carried out at about the same extent in each of the parishes.

Before looking the social and economic factors which have played an important role in field amalgamation it is very important to examine these amalgamations in the context of the physical environment in the study area. A comparison of Figures 6.1, 6.2, 6.3, 6.10 and 6.11 reveals the nature of such field amalgamations. Most of these have been carried out in the area under 100m amsl. The data also reveals that, in all parishes, all of these amalgamations are carried out in areas of soil types 77, 196 and 575, which are mainly Brown Forest soils with gleying and with some noncalcareous gleys. Though there are some further variations in sub-characteristics of these soil groups, it can be stated that on the whole, these soils can be improved for arable purposes by improving field drainage (78% of farmers, Table 6.20). Moreover, for the most part, these field amalgamations fall within class 2 of the LCA and represents the second best agricultural land in Scotland. Some of the land appears as class 3_1, which is capable of improvement for cereal crops. This is supported by the farmers' responses to questionnaires in the sample parishes, where 80% of farmers improved their field drainage system and participated in the Capital Grant Schemes, whilst 39% farmers increased their land and 55% farmers amalgamated their fields (Table 6.20).

Although the spatial patterns of field amalgamation show that it has been carried out in those parts of parishes which produced arable crops, this is the agricultural change which has been the main factor of field amalgamation in those parts of the parishes. This agricultural change appeared in two ways: change in land tenure and intensification of crops via changing cropping pattern or amalgamating small fields of the same crop. Change in land tenure influenced the field amalgamation in two ways: decline of farm holdings and change due to farmers' own decisions to purchase or sell some area of farm. Decline of farm holdings has been more significant in Ayton & Eyemouth than other parishes (Table 6.1). The reasons behind the change in farm holdings are structural policies of the CAP (The Farm Amalgamation Scheme 1973 and Payments to Outgoers 1976), farmers' own decisions due to their old age or family transfer or due to some other reason. The size of the farm encourages farmers to purchase new land or sell. Large arable farmers, in the presence of good crop prices, prefer to buy new land while small farmers prefer to rent or sell their land as they cannot afford to continue agricultural practice. Ayton & Eyemouth and Chirnside have both increased the area owned by farmers and reduced the area rented from outside concerns or rented from near relatives. In Bunkle & Preston, the area owned by farmers has declined while the area rented from outside concerns and rented from near relatives increased. This disparity between Bunkle & Preston and other parishes is mainly because of the nature of agriculture. Bunkle & Preston is more livestock-producing area. Moreover this pattern coincides with those which have been already discussed in chapter 4.

There has been significant intensification of crops (Table 6.1). This intensification appeared in the form of changes in cropping pattern. An increase in the area under wheat and oilseed rape led to change in field practice. Changes in cropping practice were carried out in those parts of farms which were suitable for wheat and oilseed rape production (Figures 6.10 and 6.11). Another way of intensification of crops is to amalgamate the present fields, because of introduction of new large farm machines which force farmers to combine smaller fields in order to save time and labour costs. There are two main factors which encouraged farmers to intensify their agricultural production: higher prices for crop production and the availability of grants to improve farm structure for intensification of crops. These two factors have been very influential, under the umbrella of CAP's guaranteed price support system and capital grants for buying farm machinery or improving field drainage. All of these patterns taken together, suggest that economic, physical and socio-behavioural factors have acted upon the rural landscape. The enlarged fields remain less than around 35 ha. This is a limit set by the physical characteristics of the area, where the natural terrain does not encourage large field sizes and where farm machinery could be used or where improvement of field drainage is difficult.

The role of these factors has emerged from the farmers' responses in the sample area (Table 6.20). Although a number of factors have affected the nature and extent of field amalgamation, it is the farmers' own behaviour which ultimately decides on amalgamation.

Another group of findings concerns changes in field boundaries. Removal and addition of field boundaries may or may not be dependent on field amalgamation. However changes obviously do take place when fields are amalgamated in order to enlarge the field size. The pattern of change in field boundaries (Table 6.8) reveals that there have been both removals and additions in the sample area. Major removals occurred in hedgerows and post & wire boundaries while the greatest new addition was of hedgerows (66% of new field boundaries). The spatial patterns of field boundaries shown in Figure 6.14 compared to Figures 6.10 and 6.11, reveal that hedgerow removal has been carried out mainly because of field amalgamations and mainly in Bunkle & Preston and Chirnside. The removal of post & wire boundaries proceeds for the same reason and is characteristic of the parishes of Ayton & Eyemouth (Figure 6.14). The factors lying behind these field amalgamations have been discussed earlier. Hedgerows have been present in the landscape since the eighteenth century when they were created as part of the improvement and enclosure movement. It is particularly interesting therefore that plantations of hedgerows have appeared all over the parishes, but in Ayton & Eyemouth they have mostly replaced post & wire boundaries. The new addition of hedgerows is mainly along roads where they have been planted, most probably, without removing the post & wire boundary (especially in Ayton & Eyemouth). This new appearance of hedgerows is due to three major factors. Government has been encouraged farmers to plant hedgerows (Blunden and Curry, 1988), the advantages of hedgerows for protecting soil erosion and as a wind breaker have been well established, whilst the beauty of landscape and farmers' own decisions to maintain the historical nature of rural landscape have played an important part over the past 20 years. Moreover, improvements of soil capability and field drainage have enabled parts of farm be planted to plant hedgerows which were, previously, not capable of planting hedgerows.

The removal of other types of boundary has not been so significant, but they also been replaced by new hedgerows. A few stone walls boundaries have been created in some places in Ayton & Eyemouth in those part of the parish where soil characteristics are not suitable for arable purposes and more suitable for livestock production. Some changes have also been carried out in the area under woodland and semi-natural vegetation bringing them into cultivation, in those parts where land can be improved through field drainage.

The removal and creation of field boundaries has depended upon the nature of underlying soils. Although the removal and creation of hedgerows and post & wire fences depends upon individual farmers' decisions, historically preference has been given to the planting of hedgerows wherever possible. As hedgerows provide good shelter from winds as well as a barrier for livestock, it can be argued that farmers have been replanting hedgerows wherever possible, but especially when grants were available. It also appears that all vegetative type of boundaries have increased in the area, reflecting the idea that farmers have preferred to plant vegetative boundaries. Individual farmer decisions are also important in this case, but in general farmers appear to favour the removal post & wire boundaries and the planting of hedgerows. Hedgerow removal only occurs because of field amalgamation where there are substantial economic benefits. The creation of stone wall boundaries reflects the fact that livestock is still a major agricultural activity.

Change in traditional farm features such as ponds, wells, dispersed trees and farm buildings was examined through questionnaires. Some of these features have disappeared in the process of field enlargement. Some areas of semi-natural vegetation have been improved for arable purposes in Ayton & Eyemouth and Bunkle & Preston. This area has been improved as a result of capital grants with an intensification of agriculture. Broad-leaved woodland has declined, mainly in Bunkle & Preston. A major part of Bunkle & Preston used to be wooded but that part of the parish was not examined in the present rural landscape analysis owing to a lack of photograph cover. Consequently, great disparity is found in the area under woodland in the sample area and in the parish statistical summaries. The patterns of woodland change suggest that the area under coniferous woodland has increased in the parishes because of its advantages over broad-leaved woodland. These results are consistent with the studies carried out by MLURI (1992) and CCS and NCC (1989). The Farm Woodland Scheme 1985 has been effective in encouraging farmers to plant woodland. However, although more money has been offered to plant broad-leaved woodland, the increase in the area of coniferous woodland shows that farmers have preferred to plant conifers for their rapid growth and commercial advantages.

6.7 SUMMARY

The sample area is an area of mixed farming. Crop production has been a major agricultural activity alongside stock farming, especially beef and sheep rearing. The area under tillage, arable and cereals has risen since 1973 while the area under grass not for mowing and rough grazing has been reduced. The area under grass for mowing has shown no major change. Wheat, oilseed rape and barley production have increased. Oats and potato production have declined since 1972. The total number of farm holdings has decreased between 1972 and 1990. The average farm size has risen in all parishes. Changes have occurred in sheep and beef production. Sheep production has increased while beef cattle production has declined to some extent. Pig and poultry production has declined greatly.

As part of agricultural intensification and accompanying decreases in the number of farm holdings, there has been a substantial amalgamation of fields. Field sizes have been enlarged and field numbers have been reduced in consequence. The removal of hedgerows and post & wire fences has been the main subject of changes in field boundaries. Some new stone wall boundaries have been constructed in Ayton & Eyemouth. Other field boundaries have shown only minor changes in length between 1974 and 1988. The area under woodland has increased. Little change in terms of the removal of farm features has occurred. Farmers have intensified crop and livestock production but there are variations within and between parishes in terms of crops and livestock production. Wheat, sheep and beef cattle have been the main focus of intensification. Capital grants schemes, the Farm Woodland Scheme and the Set Aside Scheme have been the main foci of participation in government initiatives.

The facts of reduction in the number of fields are mirrored in farmers' responses which show that they have amalgamated their fields in order to increase the area either of the farm or of individual fields to permit intensification of agriculture. Hedgerows have been removed and re-planted at the expense of other boundaries especially post & wire fences. These fences have been removed both for the purpose of field amalgamation and for re-plantation of hedgerows. Other farm features have been removed either for intensification of agriculture, field amalgamation or for establishment of new features. The re-planting of hedgerows has been supported by those farmers who participated in the Agriculture and Horticulture Grant Scheme (1980-1985) and especially the Agricultural Improvement Scheme (1985-1989).

CHAPTER 7

CONCLUSION

7.1 INTRODUCTION

This thesis set out to examine the nature of agricultural change and its impact upon the rural landscape between 1972 and 1990. The focus of this study, South East Scotland, is one of the most arable areas of Britain. The investigation utilised an integrated approach of Agricultural Returns, aerial photography and OS maps, and questionnaire survey. The overall analysis and the more detailed examination of two sample areas of different physical and agricultural characteristics were throughout allied to the work of others already published in the field (e.g. Blunden, 1985; Blunden and Turner, 1985; Bowers and Cheshire, 1983; Shoard, 1988; Munton et al., 1992; Westmacott, 1984). To investigate rural landscape change between 1972 and 1990, it was necessary to show both the patterns of agricultural change, and also farmers' responses towards agricultural and rural landscape change as well as to understand their behaviour towards CAP policies.

In review, the examination undertaken here and reviewed above in detail suggests there to be a number of principal findings. These are reviewed below in association with the work of authors whose findings have been important in the changing nature of agricultural geography.

Traditionally, agricultural geographers have emphasised the physical environment, recognising the diversity of production systems and complex patterns of spatial distribution as a consequence of the physical limits. Although physical factors do play a role in deciding the nature of agricultural production, the economic and socio-behavioural factors have also been shown to play a major role in influencing the timing and nature of change in agricultural systems. In recent years, the focus has been upon state-agriculture relations (Bowler and Ilbery, 1985; Bowler, 1983, 1985; Tarent, 1992 and others). This dissertation has sought to offer a focus which has looked at the ways in which landscape change and the facts of agricultural change and of attitudes to it can only be made sense of at the smaller scale. If it is true, as I have suggested, that since 1973, UK agriculture has been greatly influenced by CAP policies and that price support policies of the CAP have been a major determinant of agricultural intensification, it is also the case that this thesis sits in a tradition of studies that has considered the economic intensification of agriculture during the period 1973 to 1988 to be both politically 'driven' but with locally variant outcomes. In this sense, geography matters to our levels of explanation in agricultural change and in understanding rural landscape change. The work has extended for localised areas what we know of agricultural activities' larger-scale role in changing patterns of land tenure, crops and rough grazing, and the related role of initiating changes in the rural landscape (Bowler, 1985; Robinson, 1988). Since the focus of this work has been on changes in the rural landscape consequent upon agricultural change, the work sits within that 'tradition' evident in the work of Blunden and Curry, 1985; Shoard, 1980; Munton et al, 1987; Westmacott, 1984 and others.

7.2 AGRICULTURAL CHANGE

The patterns of agricultural change in South East Scotland have been evaluated during the period 1972 to 1990 on a number of grounds. Major components of agriculture - tillage, rough grazing, grass and major crops (wheat, barley, oats, potatoes and oilseed rape), and livestock (dairy and beef cattle, sheep, pigs and poultry) - were examined. The major findings are summarised here.

7.2.1 Temporal changes in South East Scotland

Changes in agriculture showed great variation between 1972 and 1990 (Appendices 4.2 to 4.24). Figure 4.2 shows that agricultural land increased (2.98%) between 1972 and 1990. The area under grass and rough grazing showed major decline during this period. Grass not for mowing (-12.05%) and rough grazing (-17.52%) decreased sharply from 1972 to 1990, but the area under grass not for mowing showed an increase between 1984 and 1990. The area under grass for mowing increased between 1972 and 1976 in South East Scotland. It declined during the period 1976 to 1988, and after 1988, it rose which is similar to grass not for mowing. On the whole, it declined (-6.94%) between 1972 and 1990. By 1990, the area under tillage (+16.35%) and cereals (+11.32%), allowing for some minor upward and downward fluctuations remained higher than in 1972. Great changes occurred in the area under wheat (+218.06%) and oilseed rape (+221.45%) in South East Scotland between 1972 and 1990 (Table 4.2). Both crops showed great increase between 1980 and 1990. Barley (-9.06%) and potato (-32.50%) showed some changes in total area between 1972 and 1990. The area under oats (-72.39%) declined rapidly between 1972 and 1990 in South East Scotland. The patterns of livestock production showed major variations during 1972 to 1990. Dairy cattle (-55.39%) and beef cattle (-7.21%) declined from 1972 to 1990. Beef cattle production increased between 1972 and 1976, but declined between 1976 and 1988. It rose again between 1988 and 1990. The production of cattle (all types) rose between 1972 and 1976, and then declined between 1976 and 1988. Since 1988, this factor showed a minor increase, but on the whole, it has declined (-16.32%) in South East Scotland. Sheep production rose (+26.87%) during this period. The production of pigs showed some variation during this period, but in the end, showed a net decline (-23.38%) between 1972 and 1990, whereas poultry production rose between 1972 and 1980, then declined between 1980 and 1984, again rose between 1984 and 1988, and finally declined between 1988 and 1990.

7.2.2 Patterns of change

Major changes in agriculture occurred in farm holdings, land tenure, areas under agricultural land and livestock production in South East Scotland (Table 4.1). Farm holdings declined continuously in the study area though an increase occurred after 1988 (Figures 4.3 and 4.6). In most arable parishes, farm holdings declined between -20 to -40% between 1972 and 1990. The decline in farm holdings resulted in a large average farm size (Figure 4.5) and larger arable fields. Great changes also occurred in the land tenure patterns (Figure 4.4). The areas owned by farmers increased (commonly by about 25%) from 1972 to 1990 in most arable parishes, but in livestock parishes increased from 1972 to 1980 only to decline from 1980, especially in beef cattle-producing parishes. The areas rented from outside concerns increased in extent from 1972 in arable parishes, and decreased in arable parishes between 1988 and 1990. Areas rented by farmers from near relatives increased in livestock-producing areas (up to +500%), especially in sheep-producing parishes. Major changes occurred between 1980 and 1984, facts which may be linked with the milk quota system and other policies concerning livestock implemented after 1980.

A decline in the area under rough grazing between 1972 and 1990 has resulted in an increase in the area under agricultural land. The total area of agricultural land also increased (Table 4.1), a fact which reflects the improvement of new land for agricultural land, chiefly at the expense of rough grazing (which decreased by -17.52%) in the region as a whole from 1972 - 1988. The area under rough grazing declined (in some parishes up to -100%) in all parishes (Figure 4.7), especially in East Lothian and Berwickshire. It increased in a few parishes of North East Fife between 1988 and 1990 but declined in some parishes of Tweeddale and Ettrick and Lauderdale during 1984 and 1990. The area under grass for mowing mostly declined in the arable parishes of South East Scotland during this period (Figure 4.7), especially in East Lothian. In sheep-producing parishes, the area under grass for mowing increased up to +50%. It rose notably in Berwickshire between 1972 and 1980, only to decline between 1980 and 1990. This land use increased mostly in the livestock-producing parishes of Roxburgh, Tweeddale, and Ettrick and Lauderdale between 1972 and 1990. The area under grass not for mowing declined in the arable parishes of South East Scotland during the period 1972 to 1990 but rose in those upland parishes suitable for sheep and beef cattle production. Woodland is more a feature of the Borders, and the upland parishes of Lothian and Fife regions. Although the change in the area under woodland has not been great, it has increased in most parishes of South East Scotland between 1972 and 1990 (Figure 4.9), especially in some parishes of Berwickshire. It has increased in the study area chiefly in consequence of the incentives of the Farm Woodland Scheme.

Despite the fact that the study area has variations in relief, soil and climate, the area under tillage has increased in all parishes (Figure 4.8), and the area under bare fallow has declined between 1972 and 1988 (Figure 4.10) because of the intensity of agricultural production. The proportion of tillage in agricultural land increased from 60% to more than 80% in arable parishes (Figure 4.8). Since 1972, the area under tillage rose in arable parishes (+50%) and declined in the sheep-producing parishes (-50%) (Figure 4.8). Changes in the area under grass (up to -50%) and rough grazing (up to -100%) made up the high rate of change in tillage (+100% and over). This rate of change appeared in most arable parishes at 10 - 50 %, but some parishes had a very high rate of change more than +100% (Figure 4.7). The reason for this high rate of change is that in parishes with small or even no land under tillage in 1972, any conversion of even a small piece of grassland to tillage will bring a high rate of change. The area under vegetables increased in the arable parishes (Figure 4.11). Other crops have some fluctuation in their area during 1972 to 1990. There are great changes within tillage especially in cereal crops. Some parishes decreased the proportion of cereals in tillage (Figure 4.12) because of the increase in the area under tillage, a fact largely due to increase in acreage of oilseed rape and the related decline in barley and oats. The rate of change in the area under cereals was often different 'within' parishes because of the change in major crops. Although the proportion of cereals in tillage declined in some parishes after 1984 because of the introduction of oilseed rape. On the whole, it rose between 1972 and 1990 (Figure 4.12). This would clearly support the work of Bowler (1985) who has noted how increase in the area under cereals has been a major feature of agricultural change in the community under the CAP.

The area under wheat and oilseed rape production increased in South East Scotland (Figs. 4.15 and 4.20). Wheat production showed a very high rate of increase (up to +200% in arable and more than +500% in some livestock-producing parishes) in the study area. The proportion of wheat in agricultural land rose from 20% to more than 40% between 1972 and 1990 (Figure 4.15). The area under wheat and oilseed rape production increased at the expense of oats, barley and potatoes. This is mainly because of high prices for wheat and oilseed rape as compared to barley, oats and potatoes. The higher CAP prices for wheat led to the higher rate of increase in the area under wheat production showing a reduction in the area under barley (mostly -50% in arable parishes), potatoes (-50%) and oats production (up to -100%). Bowler (1985) noted that the price for wheat has risen three-fold between 1970 to 1980 while the prices for barley (about two-fold) and for oats (less than 100%) remained less than wheat. The main reason for the great increase in acreage of oilseed rape is its price support which has encouraged the farmers to put more land under oilseed rape. The area under barley had variable patterns. The proportion of barley in agricultural land declined from 40% to 20% (Figure 4.16). It declined in arable parishes, but rose in livestock parishes due to stock-feeding requirements. A high declining rate in oats (from 10% of agricultural land to less than 2%) appeared in some parishes (Figure 4.18), partly because of its low price which resulted in an overall decline of 72% in South East Scotland and, in some parishes, its complete disappearance. The potato, once one of the major crops, has become the third and even the fourth crop in some arable parishes. In general, the area under tillage, cereals, wheat and oilseed rape has increased and the area under barley, oats and potatoes has declined. Bowler (1985: 87) pointed out that the CAP has combined the expanding volume of cereal production by maintaining target and intervention prices above those ruling in the world market and by providing an assured market through intervention when production has been in excess of demand inside the community.

Major changes have been found in livestock production. The reforms in milk prices and its quota system have led to a reduction in dairy cattle (Figure 4.22). Dairy and beef cattle have decreased between 1972 and 1990, though there have been fluctuation within districts and parishes at different periods of time. In 1972, density of dairy cattle per 100 ha of agricultural land was more than 50 in some parishes but this declined to 30 head in 1990 (Figure 4.22). Beef cattle declined from 200 head per 100 ha of agricultural land to less than 100 head, and even in some parishes by up to 50 head per 100 ha of agricultural land (Figure 4.23), despite the fact that the area under agricultural land rose during this period. The total number of cattle decreased by 16.32% in South East Scotland. Their density (per ha of agricultural land) decreased from 91 to 74 head (Table 4.3). On the whole, the rate of change in cattle production (all types) was from 100-200 to 50 head per 100 ha of agricultural land in parishes between 1972 and 1990 (Figure 4.25). Sheep production increased (26.87%) throughout South East Scotland. The higher density of sheep occurred especially in those parishes where land quality for agriculture is poor and limited to grassland and rough grazing (Figure 4.26). Higher rates of change occurred in sheep production: from 100 sheep per 100 ha of agricultural land to around 500 sheep per 100 ha between 1972 and 1990 (Figure 4.26). A decrease has occurred in pig and poultry production. The production of pigs and poultry has been limited to only a few parishes though it has appeared in some new parishes (Figs. 4.28 and 4.29). The rate of change in pig and poultry production was insignificant.

The subsidies - Hill Livestock Compensatory Allowances (HLCAs), Suckler Cow Premium Scheme for Beef and Sheep Annual Premium Scheme for sheep rearing - have encouraged farmers to increase production though there have been fluctuations during the period 1972 to 1990. Bowler (1985) has noted that financial assistance (Suckler Cow Premium) under the CAP for keeping breeding cows as also the HLCAs have served to continue to concentrate beef breeding in upland areas. EC sheepmeat regulation (1980) has proved a general stimulus to sheep production. Variable premiums and HLCAs have encouraged the localisation of production in upland areas of the UK and the evidence here presented would confirm this picture.

7.2.3 Changes in the sample areas

East Lothian represents a more intensive arable production whereas the Berwickshire sample area reflects a more mixed farming. In the sample areas, farm holdings decreased between 1972 and 1988 with some variations between the sample areas. The areas owned by farmers increased in the sample areas throughout from 1972 to 1990 except in Prestonkirk (decline between 1972 and 1976) and in Ayton & Eyemouth (decline between 1988 and 1990). Areas rented from outside concerns rose in the East Lothian between 1972 and 1980, and declined between 1980 and 1990 with some variations in parishes. The area rented from outside concerns declined in the Berwickshire sample area between 1972 and 1990, except Ayton & Eyemouth. The areas rented from near relatives increased in the East Lothian between 1972 and 1984 and decreased between 1984 and 1990 with variations in parishes except Morham where it decreased between 1972 and 1976 and then remained constant between 1976 and 1990. The area rented from near relatives increased in the Berwickshire sample area between 1972 and 1980, and decreased after 1980, whereas it rose in Ayton & Eyemouth between 1972 and 1988, but decreased between 1988 and 1990. The area under rough grazing decreased in both sample areas but the area under grass for mowing increased between 1972 and 1980 and decreased between 1980 and 1990 in the Berwickshire sample area whereas the area under grass not for mowing decreased in both sample areas between 1972 and 1988. It increased in Ayton & Eyemouth between 1988 and 1990. The areas under tillage, cereals and wheat increased in both sample areas during 1972 to 1990, although some small decrease occurred between 1988 and 1990 in the areas under tillage and cereals in Ayton & Eyemouth. Barley production increased between 1972 and 1980 and declined between 1980 and 1990 in both sample areas. The production of oats declined to a very low level in all parishes. Potato production declined in both sample areas excluding Morham where it rose between 1972 and 1984. Oilseed rape rose in all sample parishes between 1984 and 1990 apart from Chirnside between 1988 and 1990. In general, dairy cattle and beef cattle production declined in both sample areas except in Prestonkirk. Sheep production increased in the sample areas. Pig production generally decreased but showed some increase in Prestonkirk and in Bunkle & Preston.

This evidence is supported by farmers' responses in South East Scotland as a whole, and, specifically in the sample areas. Robinson's (1993) suggestion that there have been some strong responses to the stimuli of the CAP's price support system is proved here in the ways in which the intensification, concentration and specialisation of agriculture has led to the industrialisation of agriculture within the study area. But the evidence reviewed here also points to the need to be sensitive to the local context and aware of matters of timing and scale in documenting agricultural change.

7.2.4 Farmers' attitudes to agriculture and the CAP

The evidence of farmers' trends (Table 4.4) seems to coincide very closely with the intensification of agriculture, especially wheat and oilseed rape, and livestock, especially beef cattle and sheep production. A large majority of farmers (92 of 284) in the study area, were arable farmers, along with 104 farmers in mixed arable farming: 70% of farmers in the study area were either arable or mixed arable farmers. Only 20% were stock and stock/arable farmers. Most farmers (28 of 79) who increased their area of farms between 1973 and 1993 were arable farmers. Others were mixed arable farmers, albeit dominantly arable. In the study area, most farms were more than 100 hectares of farm size. The highest number of farms (63 of 284) had an area between 200 - 300 ha. Most of them (23 of 63) were arable farmers. The farms more than 500 ha of size were intensive livestock farming. A major percentage of farmers who intensified their crops were arable, arable/beef and arable/stock farmers (Table 4.5). Field drainage system has been improved by 165 farmers, reflecting the intensification of crops, mainly on arable and mixed arable farms. The intensification of crop production was carried out by 172 farmers while intensification of livestock production was done by 117 farmers. About 37% of crop intensification was done by arable farmers. Wheat (150 farmers) and oilseed rape (84 farmers) were the main target of intensification. This livestock intensification has mainly been carried out on livestock farms where 60 farmers intensified beef cattle and 58 increased sheep production. Their responses towards structural policies supported field amalgamation, increased field drainage for better productivity of the farm and their participation in the Farm Woodland Scheme supported the increase in the area under woodland in South East Scotland and in the sample areas. Three schemes in particular (Capital Grants Schemes, the Farm Woodland Scheme and the Set Aside Scheme) have been the focus of participation by farmers here (Table 4.6). The highest participation rates have occurred in adoption of the Set Aside Scheme

(1988) and the Woodland Scheme, almost all in the study area on arable and mixed arable farms (Tables 4.7, 5.22 and 6.22). In the East Lothian, 20 out of 28 and in the Berwickshire sample area nine of eighteen participated in Capital Grants Schemes (FHDS, AHDS, F and CGS Schemes). The Farm Woodland Scheme was participated in by five of 28 in the East Lothian sample area, mainly on arable/beef and arable/sheep farms and 11 of 18 farmers in the Berwickshire sample area. The Set Aside Scheme (1988) was participated in by 10 farmers in East Lothian and by six farmers in the Berwickshire sample area.

The total number of farmers in favour of the CAP increased from 64 to 132 in the period under review as compared to 62 who disliked the CAP policies in 1973. The large number who were neutral or undecided in 1973 had reduced to a small group in 1988, most of them involved in arable and mixed arable farming. Their responses towards the change of price support policies (Table 4.7) also suggest that they welcomed and profited from the intensification of agriculture under the price support policies. Bowler (1992: 14) has pointed out that "The CAP, for example, has maintained many agricultural prices at such favourable levels as to encourage and sustain excess production for the domestic market. In addition, the intervention system within the EC has provided, in effect, a limitless market for all the major agricultural products". The local evidence reviewed here would confirm this view but extends it, too, with regard to more exactly how the landscape has changed in consequence.

7.3 RURAL LANDSCAPE CHANGE

Changes in farm holdings and land tenure brought changes in the area of farms. Average farm size increased affecting field sizes and field boundaries of farms. Moreover, the intensification of agriculture, changes in cropping patterns and government policies concerning farm size structure have all influenced the nature and patterns of rural landscape change in South East Scotland. A summary of the major findings of rural landscape change is outlined here.

7.3.1 Farm size change

Changes in farm holdings and land tenure have brought changes in the farm sizes, an important element in the rural landscape. Farm holdings decreased in both sample areas with some variations between parishes. In East Lothian, total farm holdings decreased from 145 to 101 between 1972 and 1990. There are variations between the parishes within the sample area (Table 5.1 and 6.1). The greatest reduction was in Haddington (from 79 to 49 holdings). On the whole, the total number of farm holdings decreased in parishes except in Morham which had no change in farm holdings between 1972 and 1990. In all other parishes, farm holdings decreased between 1972 and 1988, but a general increase occurred between 1988 and 1990. This pattern is due both to changes in land tenure and to changes in CAP price support and structural policies since 1988 which have affected the nature of the agricultural economy. Decline in the total number of parishes between 1972 and 1988 has indicated that changes in farm holdings influenced the rural landscape in the form of enlarged field sizes and removal of field boundaries. In the Berwickshire sample area, the total number of farm holdings reduced from 44 to 41 between 1972 and 1990. This change is insignificant compared with East Lothian, but the change in Berwickshire has also affected rural landscape there. Major change occurred in Ayton & Eyemouth where farm holdings declined from 21 to 15 during this period. Bunkle & Preston is the only parish showing an increase throughout 1972 to 1990. A change between 1988 and 1990 occurred only in Chirnside, similar to East Lothian where increase in farm holdings appeared between 1972 to 1988 (with the exception of Morham).

7.3.2 Patterns of field amalgamation

Despite the fact that both sample areas are different on the basis of physiography and agricultural activity, the results for rural landscape change are almost the same. Field amalgamation occurred in both areas to enlarge field sizes though the extent of field amalgamation varies between sample areas because of their farming type. The areas of farms increased through the addition of new land by farmers in both sample areas. Substantial changes in field sizes and total number of fields occurred due to field amalgamation. Generally, small fields have been amalgamated in order to create large fields (Table 5.6 and 6.6). These amalgamations resulted in some very large fields (even more than 100 ha) especially in Athelstaneford (East Lothian) and Bunkle & Preston (Berwickshire). In the East Lothian sample area, the total number of fields declined from 654 to 555 (a decrease of 101 fields), and in Berwickshire, the reduction was from 578 to 502 fields (decline of 76 fields). A large number of small fields were amalgamated to create large fields (130 fields of less than 15 ha to produce 31 fields of more than 15 ha) in East Lothian, and in Berwickshire, 99 fields of less than 10 ha were re-ordered to create 15 fields of more than 10 ha. In general, East Lothian had large fields in 1972 (up to 70 ha) which got larger - more than 70 ha - by 1988. In Berwickshire, field size remained smaller than in the East Lothian sample area: in 1974 and 1988, no field was greater than 25 ha.

There are variations between parishes in both sample areas mainly due to the local nature of agriculture undertaken there (Table 5.7 and 6.7). A large number of fields (40) were amalgamated in Haddington, while only three fields were amalgamated in Morham. This difference is also because of variations in number of farm holdings and the size of the parishes. On the other hand, variations in field size change between parishes in the Berwickshire sample area were not significant. Twenty eight fields in Ayton & Eyemouth and 23 in Bunkle & Preston were amalgamated. This small change is also because of minor changes in farm holdings and the area of parishes. Field amalgamations resulted in changes in average field size. In East Lothian, it increased from 9.38 ha to 11.35 ha (Figure 5.11), while it rose from 9.49 ha to 10.02 ha in the Berwickshire sample area (Figure 6.11). A major change in average field size occurred in Bunkle & Preston (Berwickshire) where average field size rose from 11.95 ha to 21.79 ha. Blunden (1985), Blunden and Turner (1985), Shoard (1980) Munton et al. (1992) and Westmacott (1984) have all pointed out that smaller fields have been amalgamated for the ease of farm machinery with respect to agricultural intensification: this seems to be true more of East Lothian than Berwickshire in South East Scotland and to have been most marked from 1972.

7.3.3 Patterns of field boundaries change

The total length of field boundaries in East Lothian declined (Table 5.10) from 1181 km to 1143 km (-37 km change). The greatest feature in terms of removal has been in post & wire fence boundary (63.26 km) and the least significant was vegetative belt (3.25 km). The greatest creation of new boundary has been in hedgerow type (54.42 km), with the least new creation in post & wire fence boundary (0.43 km). On the whole, hedgerow boundary increased from 250.13 kms to 287.74 kms (+37.61 kms) and post & wire fence boundary reduced from 346.62 kms to 286.13 kms (-60.50 kms). The Berwickshire sample has been different from East Lothian (Table 6.10). The total length of field boundaries rose from 450 kms to 506 kms (+55 kms) which is contrary to the East Lothian sample area. The highest removal occurred in post & wire (31.78 kms) and the lowest in tree-line (2.31 kms). The greatest new creation among field boundaries was hedgerows (83.12 kms) and the lowest was in post & wire (1.95 kms). These results are almost similar to the East Lothian sample area. On the whole, hedgerow-type boundary rose from 119.96 kms to 188.62 kms (+68.65 kms), and post & wire boundary reduced from 177.09 kms to 143.64 kms (-33.65 kms) in the Berwickshire sample area. Only two types of field boundaries (post & wire, and dykes and others) declined in total length between 1974 and 1988 in Berwickshire. All other types of boundaries increased during this period, while in the East Lothian sample area, two types of field boundaries (hedgerows and vegetative belt) increased and all others declined their total length between 1972 and 1988. The variation in this pattern of change among field boundaries in the sample areas can be linked to variation changes in farm holdings, field numbers and the agricultural activity in the sample areas .

There are variations between parishes in the sample areas. In the East Lothian sample area, major removal of hedgerows occurred in Athelstaneford (-7.09 kms), while the greatest creation of hedgerows occurred in Morham (16.05 kms) and the lowest in Athelstaneford (10.66 kms), despite the great difference in area, the nature of farm holdings and in field amalgamations. In Athelstaneford, hedgerow-type boundary rose from 67.67 kms to 71.24 kms (5.28% increase), and in Morham from 33.33 kms to 47.10 kms (41.34% increase) (Table 5.12). On the other hand, in the Berwickshire sample area, a major removal of hedgerows characterised Chirnside (-6.74 kms), while the greatest creation of this boundary was Ayton & Eyemouth (+46.50 kms) with the least in Bunkle & Preston (+13.75 kms).

Post & wire fence boundary was removed in almost all parishes in both the sample areas. In East Lothian, the great removal of this boundary occurred in Haddington (20.68 kms decrease) and the lowest in Athelstaneford (7.82 kms decrease). A minor creation of this boundary (0.43 km) appeared only in Athelstaneford. In spite of the great removal in Haddington, the highest percentage change (-26.78%) of total length occurred in Morham. This is because of the nature of the total length of this boundary in Haddington (a decrease from 110.62 kms to 89.78 kms) and in Morham (from 63.72 kms to 46.64 kms). The lowest percentage change (-10.2%) was in Athelstaneford. Parishes in the Berwickshire sample area, to some extent, showed different patterns with regard to this boundary. The greatest removal of this boundary (24.90 kms) was in Ayton & Eyemouth and the lowest (2.5 kms) in Chirnside. Major creation (0.77 km) of this boundary appeared in Bunkle & Preston and minimum (0.4 km) in Ayton & Eyemouth. On the whole, the highest percentage change (-29.29%) was in Ayton & Eyemouth and lowest (-6.08%) was in Chirnside. Hedgerows, vegetative belts and tree-line type boundaries are the most common creations in all parishes in both the sample areas despite some removal of these boundaries. Stone wall boundary is an exception. It had no creation in the East Lothian sample area but some new walls did appear in the Berwickshire sample area. Yet removal of this boundary has occurred in both sample areas.

Every sort of prior-existing field boundary was removed during the amalgamation of fields. Hedgerows and post & wire boundaries were the main types. Hedgerows were removed and re-planted, however, because of government incentives for replanting hedgerows. Post & wire fences declined greatly in all parishes. Post & wire fences were removed for the purpose of field amalgamation, and as a replacement for hedgerows. Blunden (1985, 1988), Shoard (1980) Munton et al. (1983, 1992) and Westmacott (1984) and others pointed out that field boundaries especially hedgerows have been removed in order to enlarge fields sizes, and in connection with farm size changes for the purpose of intensification of agriculture to increase farm productivity.

The creation of new boundaries has, mostly, been limited to hedgerows. This boundary has been created in all parishes in both sample areas, even in Morham (which showed no change in farm holding) on a high scale. Stone walls boundary was also created during this period, only in Ayton & Eyemouth in that part of the parish whose soil was not best suited for crops. Blunden and Curry (1988) argue that Capital Grant Schemes are helpful in creating hedgerows on farms. This new creation of hedgerows boundary would appear to be off-setting the removal elsewhere of other field boundary types during the process of intensification of agriculture.

7.3.4 Changes in the area under woodland and semi-natural vegetation

The total area of woodland showed some variation within the sample areas. Data from Agricultural Returns documentated farm woodland and that for rural landscape analysis was derived from aerial photographs. In the East Lothian sample area, woodland was 432.9 ha in 1972, falling to 429.1 ha in 1988 (Table 5.21). The largest area (278.1 ha) was under mixed woodland mostly in the southern part of Haddington (about 180 ha in both 1972 and 1988), an area more than 200 metres amsl and one less favoured for cereal cultivation. The area under woodland in the Berwickshire sample area was mainly more than 70 metres amsl. Ayton & Eyemouth represents about 50% of the total wooded area in the sample area. The total area of woodland in the sample area fell from 429 ha to 420 ha. Coniferous woodland fell (-13.6%) in Ayton & Eyemouth from 175 ha in 1974 to 154 ha in 1988. Bunkle & Preston (+20%) and Chirnside (+14%) have additions of woodland. The area under non-coniferous and mixed woodland covered small areas and showed only minor change between 1974 and 1988. The fact that data from the Agricultural Returns

(1972 and 1990) showed major increases in the area under farm woodland in parishes of the sample areas would suggest that some land under semi-natural vegetation has been improved and converted to arable land in the sample areas between 1972 and 1988. In the East Lothian sample area, 27% (31.5 ha) of total semi-natural vegetation area has been brought under arable in Haddington (13 ha) and Prestonkirk (18.5 ha). In the Berwickshire sample area, 75% (40 of 53 ha) of total semi-natural vegetation area has been brought under arable (32 ha) in Chirnside and (20 ha) in Ayton & Eyemouth.

7.3.5 FARMERS' ATTITUDES TO RURAL LANDSCAPE CHANGE

Table 4.5 shows changes in the area of farms in the study area since 1973. Although the majority of farms (156) made no change to their total area, 79 farms increased and 36 farms decreased their area since 1973. The high number of field amalgamations (see Table 4.5) also reflects the fact that farmers in the area have removed field boundaries in order to enlarge fields. A majority of farmers (137) have carried out field amalgamation. Most (38.7%) were intensive arable farmers. Others were mixed arable farmers (dominantly arable farming). Field amalgamation has also been undertaken by other types of farmers who have converted grassland to crop-producing areas through removing field boundaries. Removal of post & wire fences boundary has been carried out by 83 farmers in the area, mostly (40%) on arable farms. Removal of stone walls has been only a minor feature mostly done by arable and arable/beef farmers. Other types of field boundaries have few removals compared with hedgerows and post & wire fences boundaries. In the East Lothian sample area, the number of farmers who removed field boundaries were 15 (hedgerows), five (stone walls) and 14 (post and wire fences). Most of these farmers were either arable (11 for hedgerows, four for stone walls and nine for post and wire fences) or arable/stock farming (two for hedgerows and three for post and wire fences).

Some removal of farm features has been carried out in South East Scotland. Twenty-eight farmers removed farm buildings without residence. Among these farmers, nine were in arable, five in arable/beef, four in arable/stock, five in stock and four in stock/arable farming. This pattern suggests that most of the farm buildings' removal was carried out on arable and mixed arable farm types. On the other hand, 92 farmers increased the area of their farms. Most of them are arable farmers. Five farmers in stock farming increased the area of farms, while five farmers in stock farming removed farm buildings. This trend suggests that removal of farm buildings was mainly linked with increase in the area of farms. Thirty-four farmers removed dispersed trees on their farms during 1972 and 1990. Most were arable and mixed arable farmers. Five stock farmers removed dispersed trees as well as increasing the area of farms and removing farm buildings without residence. The removal of these dispersed trees would seen to be connected with the increase in the area of farms, and also with enlarging field sizes on the farms. Only eight farms removed ponds/wells. All were arable and mixed arable. This removal may be due to increase in the area of farms, enlargement of field size or due to the process of improving field drainage as also noted by Westmacott (1984).

In the East Lothian sample area, three of 28 farmers removed farm buildings without residence, and five farmers removed dispersed trees on their farms. On the other hand 11 farmers increased their area of farms. All types of farmers participated in these removals, while increase in farm area was carried out by arable arable/stock farmers. Field amalgamation was carried out by all farmers. These patterns further confirm that removal of farm features was not only associated with increase in the area of farms but also linked with field amalgamation. Only one farmer removed ponds/wells. In the Berwickshire sample area, six of 18 farmers removed dispersed trees and three farmers removed farm buildings without residence. All were mixed arable farmers. In the sample area, only one farmer increased the area of farm, an insignificant change compared with East Lothian. Ten farmers carried out field amalgamation. Post & wire fences have been removed not only for field amalgamation but also for replacement by hedgerows. Hedgerows have been removed only for the amalgamation of fields in the areas, although it is also the case that farmers have been re-planting hedgerows without removing post & wire fences especially along the roads. Farmers also removed post & wire fences boundary because it is an easy job compared with stone walls and other boundaries.

The Farm Woodland Scheme, the Capital Grants Schemes and the Set Aside Scheme have all been participated in by farmers here. Price support policies have been favourable to farmers and change in price support has been mostly disliked. The Capital Grant Schemes have played an important role in the changing nature of the rural landscape. Initially, these schemes (the Farm Capital Grant Scheme, 1974; the Horticulture Capital Grant Scheme, 1974; the Agriculture and Horticulture Development Scheme, 1980; the Agriculture and Horticulture Grant Scheme, 1980; the Agricultural Improvement Scheme (EC), 1985) were offered for the improvement of farm structures under a five-year plan basis. These schemes were adopted by farmers to improve field drainage systems, and to buy farm machinery and other capital goods for the improvement of farms. The participation of farmers in these schemes accelerated the intensification of agriculture. Later, these schemes (the Agricultural Improvement Scheme (national), 1985; and the Farm & Conservation Schemes, 1989) were offered to improve environmental and landscape aspects of the farms especially through planting hedgerows, erecting stone walls and post & wire fences etc. These schemes have, therefore, been significant in changing farm landscapes and in affecting the rural landscape through continuous process of removal and new creation.

7.4 COMPARISON OF THE MAJOR FINDINGS IN THE TWO SAMPLE AREAS

7.4.1 Introduction

The sample areas in South East Scotland represent two different landscapes. The East Lothian sample area represents a lowland plain of glacial and fluvial glacial deposition with gentle topography. Moreover, the area belongs to an historically intensive crop-producing region. On the other hand, the Berwickshire case study represents a glaciated upland landscape of greater elevation and more **rugged** terrain. The historical landscape comprises a mixed crop and livestock-producing economy. A large part of the East Lothian sample area lies at an elevation of less than 50m amsl, while in Berwickshire only the area along the coast is at a **lower** altitude and this narrow zone suddenly rises to 100m amsl or more typical of the Southern Upland landscape.

As a result of topography, drainage and parent material the soils of both sample areas differ from each other significantly and this has had a marked affect on agricultural economy and landscape. In spite of occurrence of LCA classes 2 and 3_1 which cover both sample areas, the land capability for agriculture differs considerably. In both sample areas soils are varied and are generally free working but more extensive patches of **clay** occur in Berwickshire. In East Lothian, with the application of powerful machinery, soils have been deeply ploughed but in Berwickshire the main obstacle to such deep cultivation has been stones and sometimes boulders. In Berwickshire the upland or livestock-rearing farms have thinner, stonier and soils of poor natural fertility. Many of the soils on the hill farms are characteristically shallow and not easily ploughed.

East Lothian is rich in lime, phosphate and potash but in Berwickshire the arable area, the livestock-rearing farms and, particularly, the hill sheep farms tend to be deficient in lime and phosphate. East Lothian has an intensive system of crop rotation which includes only one year of grass while a three year ley is typical of low ground arable farming in Berwickshire and on the livestock-rearing land, the ley remains for four to seven years or on the hill sheep farm for six to ten years.

In East Lothian, the combination of good fertility, gentle slopes and adequate drainage has made this area of the best for crop production in the United Kingdom. On the other hand, the combination of poor fertility, steeper slopes and outcrops of rock makes Berwickshire unsuitable for intensive cropping and favours a large grass acreages with the an emphasis on the breeding of sheep and cattle.

The major differences between the landscapes of the two sample areas have always reflected the patterns of agriculture. A comparison of agricultural and rural landscape change will be discussed separately in the next sections.

7.4.2 Agricultural change

A comparison of the sample areas points to the following similarities and contrasts in agricultural change in the sample areas between 1972 and 1990:

Similarities in the sample areas

East Lothian	Berwickshire
The area under agricultural land, tillage and cereals has increased.	The area under agricultural land, tillage and cereals has increased but to a lesser extent than East Lothian.
The area under rough grazing, grass for mowing, grass not for mowing, oats and potatoes has decreased.	The area under rough grazing, grass for mowing oats and potatoes has decreased but grass not for mowing showed minro change.
Wheat and oilseed rape have intensified.	Wheat and oilseed rape have intensified.
Cattle production has declined.	Cattle production declined but remained a main activity in the area.
Farm woodland has increased.	Farm woodland has increased.
Dairy cattle production declined	Dairy cattle declined but has been mo
Sheep production has increased in the sample area	Sheep production has increased in the sample area
Farmers participated in the capital grant schemes, increased field drainage and crop intensification.	Farmers participated in the capital grant schemes, increased field drainage, and crop intensification.
East Lothian remained an intensive arable area.	Berwickshire remained a mixed arable and stock producing area

Contrasts in the sample areas

East Lothian	Berwickshire
Farm holdings appeared to decline in all parishes, except for Morham.	Farm holdings declined in Bunkle & Prestonkirk but a small increase occurred in other parishes.
The area owned by farmers increased and the area rented from outside concerns and near relatives was reduced.	The area owned by farmers increased and the area rented from outside concerns and near relatives reduced in Ayton & Eyemouth and Chirnside but in Bunkle & Prestonkirk the area rented from near relatives increased.
The area under barley reduced.	The area under barley showed small decline but increased in Bunkle & Preston
The area under grass not for mowing has decreased in all parishes	The area under grass not for mowing remained constant in Bunkle & Preston but decreased in other parishes.
Beef cattle production declined	Beef production declined but remained a major activity in the area.
Farmers did not intensify livestock production.	Farmers intensified livestock production.

Factors of agricultural change

Economic incentives (higher prices) have been major determinants of change in cropping patterns
Physical characteristics have been major factors in determining the nature and extent of agricultural change
The availability of capital grants influenced the agricultural intensification
Policy measures have been effective to control the extent and patterns of agriculture

The major findings are divided into three parts: similarities in the findings, contrasts in the findings and considerations of the factors of agricultural change. These similarities and contrasts will be discussed here one by one along with the factors of change. The major factors which differentiate the patterns of agriculture in both sample areas are physical characteristics, land tenure, economic incentives, the availability of capital grants, farmers' individual decisions and the nature of the farms.

Similarities which are found in the sample areas mainly result from the economic incentives and policy measures. In both areas, the area under tillage, wheat and oilseed rape has increased but the area under rough grazing, grass for mowing, oats and potatoes has declined. This is because of the price support policies which have been successful in changing cropping patterns. Decline in dairy cattle production, increases in sheep production and increases in the area of farm woodland have also been due to policy measures (the Farm Woodland Schemes). The decline in the number of dairy cattle in the sample areas is linked with the price support policy and milk quota system under the CAP. The higher prices for cereals and oilseed rape have influenced the case studies by encouraging farmers to put more land into arable production resulting an increase in the area under tillage, cereals and oilseed rape. In spite of intensification of crops because of these economic incentives and even the farmers' own willingness to shift concentration from livestock to crop production, both have survived to maintain the historical nature of agriculture. East Lothian remains an intensive arable area and Berwickshire has remained a mixed arable and livestock producing area.

Contrasts in the major findings are more important than similarities as they truly show the role of landscape in agricultural change. A major difference is evident in the changes on farm holdings in the sample areas. The number of holdings has significantly declined in East Lothian with the exception of Morham. Only a small change appears in the Berwickshire parishes. This difference is mainly because of two factors: the nature of agriculture and number of farm holdings on the start of the period. The East Lothian case study has three large parishes which are intensively cultivated. Arable areas tend to have smaller farms because even a small arable farm can support a family while livestock farms need a larger area in order to provide enough grass and rough grazing resources. This factor is reflected in the sample areas. In spite of great changes in farm holdings in the East Lothian sample parishes, this area still has more farm holdings than the Berwickshire sample parishes. As the emphasis of structural policies has been upon the intensive arable areas, so decline in number of farm holdings in livestock producing areas has been minimum.

Another contrast between the sample areas is in land tenure change. Under economic pressure, small farmers may forsake agriculture to adopt some other form of income. This has occurred in the sample areas where, under the structural changes of the CAP or because of higher economic pressure on farms, farmers have been leaving the land and hence the decline in farm holdings and an increase in the area owned by farmers which has occurred in East Lothian. On the other hand, in the Berwickshire sample area, which combines both arable and livestock production, farmers have tended to rent their land. This has been largely associated with livestock production. It is hard to find the exact reason for this pattern but it can be assumed that, most probably, small livestock farmers who were not able to continue to operate profitably because of low incentives for cattle production and unimproved soil and terrain characteristics for crop production, have been renting their land to their relatives instead of selling their land. Moreover, in arable areas under the prevailing higher prices for cereals, landlords might have tried to increase the rent of the land or refused to increase the length of the leases which has resulted in abandonment of the agricultural practice.

The difference in grass and barley production between the sample areas is a reflection of the nature of agricultural patterns. Because sheep and cattle production remained a major activity in the Berwickshire case study, so grass not for mowing and barley production showed small changes. The nature of agriculture is reflected from the farmers' responses who, in East Lothian, did not intensify the livestock production whereas in Berwickshire livestock production was increased

Within the broad determining influence of the physical environment, the role of government in influencing the rural landscape cannot be ignored. Government has tried to provide some grants for those types of area which cannot sustain their agricultural identity because of the adverse physical environment. Such measures include the Less Favoured Areas and Environmentally Sensitive Areas Acts (Robinson, 1993). The availability of capital grants for the improvement of farm structure is also an aspect of government role in the agriculture. Price support policy of the CAP has been major determinant of agricultural change in the areas.

Although the patterns of change in agriculture suggest that economic incentives offered by the CAP and government have been the main influential factors in agricultural change between 1972 and 1990, it cannot be denied that physical factors in the area, as well as farmers' own decisions, always play an important role in setting the patterns of agricultural change. The farmers in the East Lothian sample are mostly arable and in the Berwickshire sample area they are mostly mixed (arable/beef and arable/sheep) and their responses to policy changes clearly reflect the different nature of agriculture in the two sample areas.

In East Lothian, most farmers have intensified crop and reduced livestock production but in Berwickshire farmers have intensified crop as well as livestock production. Farmers' participation in capital grant schemes, increased field drainage, the Farm Woodland Scheme and the Set Aside Scheme presents an environment which combines the major factors of agricultural change - the physical characteristics, economic incentives and farmers' decisions. These factors have been shown to determine the extent and nature as well as the differences in the character of agricultural change between the sample areas.

7.4.3 The rural landscape change

The analysis of rural landscape data for both sample areas has shown that there have been great changes in field size in order to accommodate improved farm machinery and to reduce farm labour - a part of the ongoing agricultural intensification. Intensification has been the means of changing the rural landscape, especially through amalgamations of fields and the removal of hedgerows. The similarities and contrast of the major findings are discussed one by one along with the underlying factors.

Major factors of rural landscape change

Agricultural change
Physical characteristics of the area
Availability of capital grants and other schemes
Farmers' personal decisions

Similarities and contrasts in field amalgamations

East Lothian	Berwickshire
A large number of fields have been amalgamated. More field amalgamations have occurred than Berwickshire.	A large number of fields have been amalgamated.
Almost all of the field amalgamations are carried out in those parts of the sample areas which are less than 100 metres amsl. A large number of field amalgamations are under 50m amsl.	Almost all of the field amalgamations are carried out in those parts of the sample areas which are less than 100 metres amsl. Almost all amalgamations are above 50m amsl.
Field amalgamations are done in those parts of the sample areas which come under class 2 and 3_2 of LCA and where soil types are brown forest soils with gleying and with some noncalcareous gleys and where land drainage can be improved	Field amalgamations are done in those parts of the sample areas whose come under class 2 and 3_1 of LCA and where soil types are brown forest soils with gleying and with some noncalcareous gleys and land drainage can be improved
Small fields (less than 10 ha) have been the main target of field amalgamation in both sample areas	Small fields (less than 10 ha) have been the main target of field amalgamation in both sample areas
Larger fields (more than 70 ha) were found in 1972 and 1988	Small fields (less than 35 ha) were found in 1974 and 1988
The extent of field amalgamation within the sample area is influenced by the size of the parish and the number of farms in the parish except in Morham.	The extent of field amalgamation within the sample area is influenced by the size of the parish and the number of farms in the parish

Similarities and contrasts in field boundaries

East Lothian	Berwickshire
The total length of field boundaries has declined.	The total length of field boundaries increased.
Hedgerows and post & wire fence boundaries have been the main target of removal. Post & wire fence boundary has been removed more than Berwickshire.	Hedgerows and post & wire fence boundaries have been the main target of removal.
Major new plantation of hedgerows has appeared everywhere in the sample area.	Major new plantation of hedgerows has appeared. Most new plantation appeared along roads.
Removal of hedgerows has been associated with field amalgamations in the sample areas	Removal of hedgerows has been associated with field amalgamationsbut is less than East Lothian.
Vegetative, tree line, dykes & others boundaries have been removed and added	Vegetative, tree line, dykes & others boundaries have been removed and added
There are variations within the sample area in the removal of hedgerows	There are variations within the sample area in the removal of hedgerows
The removal of post & wire has been, associated with field amalgamations	The removal of post & wire boundary is associated with field amalgamations, mostly in Ayton & Eyemouth
Stone walls boundary have been removed but did not reappear.	Stone walls boundary have been removed but also reappeared in Ayton & Eyemout.
Some decrease has occurred in the area under woodland with some variations in sub-types and between parishes	Some decrease has occurred in the area under woodland with some variations in sub-types and between parishes
More area of semi-natural vegetation has been brought under cultivation than Berwickshire.	Some area of semi-natural vegetation has been brought under cultivation.
Some farm features have been removed in the sample areas but this activity has been less significant	Some farm features have been removed in the sample areas but this activity has been less significant

The rural landscape change is a function of two major factors: agricultural change and the physiography. These two factors are acted upon by individual farmers' decisions. Moreover, the components of rural landscape are highly inter-related . Modification in one component results in change in another. The analysis of these above mentioned findings will be carried out here under four aspects of landscape change: field amalgamation, field boundaries, woodland and semi-natural vegetation and the factors of landscape change in general.

(1) Field amalgamation is the most important aspect of rural landscape change. In both sample areas, field amalgamations have occurred in those parts of the parishes which are below 100m amsl, have good quality soils and come mostly under class 2 and 3_1 of LCA. The study areas under examination were 6136 ha in East Lothian and 5489 ha (89% of the East Lothian sample area) in Berwickshire. The net changes in the number of fields were 99 (-15%) in East Lothian and 76 fields (-13%) in Berwickshire. This suggests that field amalgamation was carried out with the same intensity in both sample areas. But there are variations in field amalgamations between parishes in the sample areas. These variations result mainly from different the physical characteristics of these parishes (soil types, climate and topography) as well the variations in parish size and in the numbers of farm holdings. Morham, because of its small size and fewer farm holdings, has amalgamated a smaller number of fields than Haddington and Athelstaneford. On the other hand, in Berwickshire a smaller number of field amalgamations was carried out in Ayton & Eyemouth than in Bunkle & Preston and Chirnside.

In both sample areas, the highest rate of field amalgamation occurred with fields less than 10 ha, with a decrease of 105 fields (16%) in East Lothian and 89 fields (15%) in Berwickshire. The enlargement of fields has created fields of 35 ha and above (12 new large fields in East Lothian). Some very large new fields have been created in the East Lothian sample area. The highest changes have been in areas which previously had the smallest fields. A major difference between field amalgamation in the sample areas is indicated by the Berwickshire samples where area, field sizes were less than 35 ha in both 1974 and 1988, whereas in the East

Lothian sample large field sizes (more than 70 ha) were present in 1972 and in 1988. This great disparity can be associated to the topography i.e. difference between the sample areas, as indicated earlier. Moreover, other factors such as the limit of farm boundaries and land tenure also affect on the patterns of fields' shape and sizes. These patterns clearly reflect the process of field amalgamation not only in the sample areas but also the field amalgamation in other arable areas of South East Scotland during the period 1972 to 1990. The amalgamation of fields has affected the average field size in spite of differences in intensity. The average field size rose from 9 ha to more than 11 ha in both sample areas.

(2) Although field amalgamation has been a major activity in the sample areas. The most important aspect of field amalgamation and rural landscape change is the removal of field boundaries. The major findings which consist of similarities and contrast between the sample areas will be analysed next.

Between 1972/74 and 1988, the total length of field boundaries declined (-3.6%) in the East Lothian sample area and increased (+12.4%) in the Berwickshire sample area. A total length of 117.46 kms (9.9%) was removed and 87.15 kms (7.3%) added in the East Lothian while 67 kms were removed and 125 km added in the Berwickshire sample area between 1972/74 and 1988. This variation between sample areas is mainly less removal of post & wire fence boundary and higher plantation of hedgerows in the Berwickshire sample area. The higher level of removal of field boundaries in East Lothian is associated with its intensive arable agriculture. Most field boundary removals have been of hedgerows and post & wire fences.

The planting of hedgerows in Berwickshire has been more greater East Lothian whilst more post & wire fences were removed in East Lothian than Berwickshire. The patterns identified here reflect removals of hedgerows for field amalgamation but with subsequent additions to replace post & wire fences. The great replanting in the Berwickshire sample area is due to new plantings in Ayton & Eyemouth, where the greatest length of post & wire fences was removed. It seems that in the East Lothian sample parishes, hedgerows and to some extent post & wire fences were removed for field amalgamation. The exception is Morham where most of the new hedgerows replaced the post & wire fences. In the Berwickshire sample parishes, hedgerows have been removed for field amalgamations, with an exception the Ayton & Eyemouth where post & wire fences have also been associated with field amalgamation. At the same time, new plantations have appeared along roads in this parish.

Although in both sample areas most of the new planting of hedgerows has occurred along roads, the most prominent example has been in Ayton & Eyemouth. One of the reasons for planting new hedgerows along roads is that it does not require removal of existing fences and, moreover, it provides a shelter for fields from erosion and gives security from the roads as well as having aesthetic value. Among other boundary types, vegetative belts and tree lines have been added as well as removed in the sample area but they are of limited significance. New stone walls were added only in Ayton & Eyemouth, in those parts which are not suitable for arable purposes but connected with management of livestock. The removal of non-vegetative field boundaries with very little new addition, is likely to be due to farmers' personal decisions keeping in mind the benefits of time and economic savings.

(3) The total area under woodland declined to some extent in both sample areas. However, within woodlands, conifers have increased where broad-leaved and mixed woodland have, generally, declined. The highest increase occurred in East Lothian, where coniferous woodland increased by 24.2% and the largest decrease occurred in Berwickshire where mixed woodland decreased by 28.2%. On the other hand, the area under farm woodland, as recorded in the parish summaries of the case studies, increased between 1972 and 1990. One of the reasons for the apparent discrepancy is that rural landscape data do not cover the whole parish, and secondly, that the new plantations, which were created after 1988 under the Farm Woodland Scheme or the Set Aside Scheme, were not recognisable from the aerial photographs. The patterns of woodland change for the region as a whole are quite different from the changes shown in farm woodland for the sample parishes. The reason is that the data from the aerial photos do not cover the whole area of sample parishes. The parish summary

data provide information on the total area under farm woodland without any sub-type information. The increase in coniferous planting is likely to relate to the more rapid growth of conifers compared to deciduous trees, yielding greater profit.

Although the government has provided more grants for broad-leaved than coniferous woodland such as the Farm Woodland Scheme in 1973 and the 1981 Forestry Grant Scheme (an extra £230 per ha was offered for Broad-leaved plantations), farmers have been planting conifers because of growth advantages and tax concessions. "There can be little doubt that the area of private woodlands would not have shown substantial increase in the last 30 or 40 years in the absence of a favourable tax system" (Blunden and Curry, 1988: 68). Shoard (1980) states that "When the trees are to be felled, a simple tax avoidance measure (shifting from Schedule D to Schedule B) enables the timber to be sold entirely free of tax" (Shoard, 1980: 54). In 1988, these tax concessions were removed by the government, but, as Blunden and Curry, (1988) suggest, the Woodland Grant Scheme (1988) was intended as a direct replacement. These tax concessions and rapid growth of conifers have been the major factors behind the decline of broad-leaved trees and increase of coniferous woodland in the case study areas. The woodland change represents similar patterns of removal and re-plantation to those suggested by CCS and NCC (1989), MLURI (1992) and Westmacott (1984).

(4) Semi-natural vegetation has been removed in order to improve the land for arable purposes. During the period 1972/74 to 1988, 26.7% (East Lothian) and 75.7% (Berwickshire) of the areas under semi-natural vegetation were brought under cultivation, with some variations within the parishes of the sample areas. Some removal of farm features has been carried out by farmers in both sample areas, though this removal is mainly associated with arable farms reflecting how agricultural intensification has had more impact on the landscape on farms.

Agricultural change is the most important factor of rural landscape change. Changes in farm holdings, cropping patterns, farm size structure and intensification of agriculture all contribute to the modification of rural landscape.

A major reduction in farm holdings especially in East Lothian has been effective in changing farm and field boundaries as well as land tenure patterns. Land tenure change has, historically, been proved one of the main factors of rural landscape change. If we see the origin of the present landscape in the eighteenth century, it is well proved that land tenure has been very effective in reshaping the rural landscape. It is not only a matter of renting farm land or buying and selling farm land which results in changes in field and farm boundaries as well as other farm features but there are the conditions of leases which play an important part in the modification of rural landscape. Long leases provide economic and to some extent spiritual satisfaction to the tenants which encourage them to concentrate on their farms with respect to changes in the visual landscape of the farms. Further, a condition of enclosure with the lease bound the farmer to change the appearance of the farm. This sort of condition was imposed by the lairds in the eighteenth century which resulted in the present landscape.

The intensification of agriculture is the most important element of agricultural change which has proved itself a driving force of agricultural and rural landscape patterns since eighteenth century. Under agricultural improvement, the present rural landscape was formed, and in the present century during the industrialisation of agriculture it began to be reshaped. The introduction of new farming methods, new crops and farm machinery influenced the farm holdings, farm sizes, field sizes, field boundaries and other farm features as well as the infra-structure of the rural landscape. Both sample areas have intensified their agriculture resulting in changes in the nature and extent of agriculture. Field amalgamations have been carried out and the nature of field boundaries completely changed in the sample areas.

Changes at farm level are another important element of agricultural change. Farm size itself determines the nature and extent of agricultural and landscape change. Improvements in the farm size structure contribute to the modification of the landscape. Further, the availability of capital for planting hedges or creating other boundary types contributes effectively to the process of reshaping rural landscape.

The role of these factors is very well reflected by farmers' responses in the sample areas.

Although the effects of physical characteristics can be improved to some extent, in the long run they do not permit unlimited modification. So the extent of agricultural change at regional and local level, which plays an important part in changing rural landscape, is also determined indirectly by physical factors. Physical factors have been differentiating the nature of agriculture in the sample areas since the begining of land **clearances and settlement**. Given the physical environment, East Lothian has remained an intensive arable area whereas Berwickshire has remained a mixed arable and livestock producing area. Even with economic incentives for intensification of crops, it has not changed its identity.

The physical characteristics (soil, terrain, altitude) set limits to the nature and extent of rural landscape change. The present rural landscape is a reflection of these physical factors. The quality of soil decides not only the nature of crop but also the nature of the field boundary. The creation of new field boundaries depends upon the soil quality. If the quality of soil can be improved then there are opportunities to plant vegetative types of boundaries. This pattern has occurred in the sample area, where under the grants for farm improvements farmers have succeeded in planting new boundaries, especially hedgerows. The nature of terrain limits the field size. Gentle terrain allows large field sizes while rugged terrain supports small sizes of fields. This pattern is clearly visible in case studies where East Lothian has larger field sizes both in 1972 and 1990.

The participation of farmers in farm improvement schemes reflects their desire to improve farm structure in order to increase the area of farms, fields and farm productivity. Initially, these schemes (offered by EC) provided money for buying large farm machinery and for improving field drainage systems in order to increase productivity. Later, through AIS (National) government initiated the idea of farm conservation and further replacing AIS by FCGS the effort (providing money to farmers) to improve the farm landscape through planting hedgerows and stone walls, Blunden and Curry (1988).

7.5 THE WIDER IMPLICATIONS OF THE STUDY

7.5.1 Introduction

Although the study has been carried out on a limited scale both temporally and geographically, it has deliberately focused on the detail of two representative landscapes of South East Scotland. Agricultural change was examined through a number of major variables, and rural landscape change was investigated using an integrated analysis of aerial photographs, OS maps and through the preliminary application of GIS. The sample areas were selected on the basis of availability of aerial photographs, differences in physical characteristics and type of agricultural activity.

The aim of this research was to investigate rural landscape change from an examination of the extent of agricultural change. Changes in the rural landscape are analysed using an integrated approach combining aerial photography, OS maps on a scale of 1: 25, 000 and by means of a questionnaire survey. The restrictions of availability of data, the absence of accepted technique for the type of analysis, the use of postal questionnaire survey, and more importantly, the time available constrained the range and detail that was possible to be covered in the two sample areas.

7.5.2 Significance and amplification of the study

1. The most significant finding of this study is its suggestion that new rural landscape features, especially hedgerows, are being widely re-planted particularly replacing post & wire fences in both sample areas. At the same time, the research shows that hedgerows have been removed in the process of field amalgamation because of agricultural intensification in the arable parts of the country.

But the most important aspect of the study is that it also contradicts trends discussed in several previous studies. It indicates that the plantation of new hedgerows has been greater than the rate of removal in spite of agricultural intensification. These are unique results which have not been suggested by any other comparable study. Although Blunden and Curry (1988) have mentioned that AIS has been helpful in planting new hedgerows, their views were based on limited personal observations. This finding makes the study significant in pointing to an important current trend in landscape change.

2. The study further concludes that intensification and concentration of agricultural production has affected the rural landscape, with, in particular, an emphasis upon field boundaries, especially removal of hedgerows and post & wire fences. Similar trends, but not as detailed as in this local study, have been noted by Blunden and Curry (1985, 1988), Shoard (1980), Ward et al. (1985, 1991) and others.

3. Agricultural intensification has altered the rural landscape but it can not be argued that changes in cropping patterns, enlargement of fields or land tenure changes have been marked solely by the form of field amalgamation and removal of field boundaries. Instead, there is a greater probability that, as the present landscape was created under the agricultural improvement in the eighteenth century, so it is also possible that current trends have created new field boundaries with hedgerows that are being re-planted.

4. One of the most important aspects of this study is that it probed a relationship between landscape change, agricultural change, government policy measures and farmers. Bishop (1993) has emphasised that financial instruments (grants, ESAs, incentive) are the most important countryside tools which with other methods (advice and information and other schemes) can be very helpful in controlling the countryside change. This study indicates how government policy measures and farmers' attitudes to economic incentives have been influencing the agricultural and rural landscape.

5. It also indicates that the price support policies since 1988 and the more recent introduction of the Farm Diversification Scheme, the Set Aside Scheme (1988) and the Arable Area Payments Scheme (1993) have encouraged farmers to alter the nature of rural landscape. Farm conservation schemes (AIS and FCGS) have been attractive to farmers, although Morris and Potter (1995) fear that the farm grants are only temporary bribes and will only have a transitory effect. However, they ignored

the fact that the "atmosphere" (price support policies) under which field amalgamations were occurred, has changed. It can be argued that if field amalgamation continues to take place in future, which is unlikely under present circumstances, it will no longer have the same effects which prevailed before 1988. Moreover, farmers who have re-planted hedgerows will not remove them without proper reason. Further, it could be pointed out that those areas which have already experienced extensive agricultural changes would have less probability of any further landscape change.

6. The factors behind the re-creation of landscape are not only the capital grant schemes but also farmers' behaviour; they have a renewed conscience about the aesthetic view of rural landscape. The examination of farmers' behaviour towards agricultural and rural landscape change is very important as their role is a key element in this process. Unfortunately, their role in the changing rural landscape has been overlooked by most earlier studies. This present work has considered and examined their role to agriculture and rural landscape and responses from case studies have provided valuable information about agricultural and landscape change.

7. Most previous studies concentrated on one sample area but present research is based on two contrasting case studies. If rural landscape change has to be linked with agricultural change, then a study should evaluate at least two sample areas to find a more coherent picture of the relationship between rural landscape change and nature of agriculture. This aspect has been ignored by most of earlier studies., conceptually on a particular land use system.

8. The extent of the area under examination is also an important determinant in examining the rural landscape change. Most previous studies were based on small sample areas. The present study chose two sample areas, each of about 100 km^2. This aspect of the study provides a more coherent and valuable examination.

9. Another important aspect is that the research not only examined rural landscape change in the case studies but also all the major elements of rural landscape change. These include economic incentives, the physical environment and farmers' behaviour. Previous studies have not undertaken examination of all these

factors at the same time, so the present study can claim to be one of the most comprehensive in examining the nature and extent of rural landscape change.

7.5.3 Critique of methodology

Although the results of this study provide a sufficient level of knowledge about changes in the rural landscape to establish the findings considered above it is important to point out that certain aspects of this study could have been improved if all the prerequisites could have been fulfilled.

1. The aerial photographs used were drawn from different sources with different scale and colour. The 1972/74 set of aerial photographs was black & white at scale 1: 7, 500 and a second set of aerial photographs was in colour at scale 1: 25, 000. Colour and scale have been shown to be extremely useful in the recognition of rural landscape features; consequently the availability colour photographs at the larger scale (1: 7,500) for the whole of the area would have provided more detailed information than the present study.

2. The OS maps were used at scale 1: 25,000 for this study but large-scale maps such as 1: 10,000 inevitably show more rural landscape features. The use of large scale maps would not only be helpful in the selection and recognition of landscape features, but also, for the greater level of accuracy. Unfortunately map on this scale was only available for selected areas.

3. Field surveys are the most important way of supporting the use of maps and photographs exploring rural landscape change. In this study, postal questionnaire surveys are used and this constrained the level of data acquired. A relatively short questionnaire was sent to farmers in order to elicit a higher response rate. This strategy was successful, with a ca. 50% response achieved. However, it must be recognised that there is a trade off between length of questionnaire and the response rate. A larger questionnaire may yield more information about details of farms and decision-making but, fewer responses are likely to be obtained. However, it could be argued that even a small response would be helpful in providing additional information which could be useful in examining the patterns of change in the rural landscape.

4. Field surveys by direct interviews would be more likely to provide the detailed answers about different aspects of landscape change, including interactive questions to follow up a line of enquiry in greater depth. However, interviewing farmers has certain disadvantages, particularly for an arable area often becoming subjective and always demanding a great deal of time.

5. The most important aspect of field survey in any landscape study is ground truthing. This means that if the initial examination of the rural landscape has already been achieved using aerial photographs, then the results can be authenticated by going to the field area and checking accuracy. It is appreciated that the limits undertaken during the present analysis are no substitute for detailed fieldwork.

6. Using a GIS and the availability of digital data from OS, rural landscape change can be examined in more detail. The use of digital data may be an expensive option, but given the availability of resources, it would reduce not only the time required for such a study but might also make it possible to investigate a number of areas over rather larger periods than undertaken here. Digitising data from various sources was not considered a viable option. The aerial photographs can also be used for landscape analysis using an integrated approach with digital image processing and a ground survey. There are numerous directions which could be pursued - starting with simple overlay procedures, moving towards query language within a relational database (such as Oracle) possibly countered with the development of models of landscape change. Increasingly use of this data source in the future and its compatibility with various types of GIS software will enable it to supersede many other data sources.

7.5.4 Future research

1. This study focused on specific aspects of the rural landscape. However it does provide the basis for further studies which can be carried out on a greater depth. For example, the sample areas were intensive arable and mixed arable, but a useful study could be carried extending the examination to areas of intensive livestock. The use of parish summaries for continuous years would provide detail about temporal changes which could be helpful in understanding the role of agricultural change on landscape. Moreover, this study has focused upon South East Scotland, but study of other analogous areas might reveal further elements to be of significance and that other scales of observation might be more important.

2. At a small scale, agricultural change can be examined using remote sensing techniques. Although the resolution of presently available satellite images does not provide sufficient information for detailed (for instance field boundaries) research, with the acquisition of such high resolution data, in-depth analysis of different aspects of agricultural change can be carried out.

3. The role of government policy is very important in the farmer-state relationship. Satellite imageries can be used to monitor policy developments. Recently, the EC has used remote sensing data to investigate the claims by farmers under the Set Aside Scheme (1993). Studies can be carried out to monitor either ESAs and LFAs or government schemes such as the Set Aside Scheme, the Farm Diversification Scheme and the Farm Woodland Scheme.

4. More detailed investigation of remote sensing data in this type work would be expensive, but the integrated use of such data with use of aerial photographs, agricultural statistics, maps, questionnaire and ground surveys may open up new angles on agricultural change, and might even be helpful in predicting the yields of crops and the productivity of agricultural land. Although efforts have been made to evolve some yield productivity models which up to now have not proved very successful, perhaps, perhaps, a time series model of agro-climate relationship could be developed to see the long term effects of climate on agriculture.

5. A study of detailed field amalgamations with respect to cropping patterns (i.e. the nature of crops or livestock), shape and sizes of the fields and the land tenure patterns, could provide another set of data which would be helpful in understanding the relation between field amalgamation and land tenure, cropping patterns or changes in farm amalgamation.

6. The detailed analysis of patterns of hedgerows with respect to cropping patterns, government policies, farm structure, soil erosion, topography and farmers' behaviour can be extended over time to analyse both the pattern and rate of rural landscape change. Detailed analysis of field boundary locations can provide some interesting relationships between field boundaries and physical characteristics as well as socio-behavioural and economic aspects of farms.

A study to evaluate the changes in woodland patterns would be able to explore the nature of woodland with respect to physical and ecological resources as well as their relationship with to economic incentives. The examination of rural landscape change can be further explored in terms of its impact on the wild life (an integral part of the rural landscape), or on the environment.

Landscape change is a process of creation and modification with the passage of time. It has been confined that the present landscape of South East Scotland was created in the eighteenth century. Since then it has undergone a continuous process of change. The forces of agricultural revolution, urbanisation and industrialisation have been reshaping the countryside. There are opportunities to undertake studies necessary to analyse these highly influential forces of landscape change. More recently, government intervention in agriculture and countryside via ESAs, LFAs and conservation schemes, has opened up further ways of examining rural landscape change. Nevertheless, rural landscape change always depends upon farmers' attitudes and behaviour. This study tries to set out the relationship between behaviour, economic incentives, and agricultural and rural landscape change. There is a need to explore in detail the relationship between farmers' decisions and rural landscape change. Questions that need to be asked include whether farmers re-planted hedgerows as a result of their own wishes or because of economic incentives, and whether farmers' modify landscape because of land tenure conditions, cropping patterns or due to improvement in farms structure and physiography.

The process of landscape change is intensely dynamic and to construct a meaningful model of long term trends, requires that comparable studies be undertaken to provide a time series. The present research is one snapshot of this long term evolution.

Appendix 1.1 Names and numbers of civil parishes

	LOTHIAN		FIFE		BORDERS		
PN	**East Lothian**	**PN**	**North East Fife**	**PN**	**Berwickshire**	**PN**	**Ettric and Lauderdale**
350	Dunbar	**374**	Abdie, Newburgh	**243**	Ayton & Eyemouth	**265**	Channelkirk
351	Innerwick	**375**	Auchtermuchty	**244**	Bunckle & Preston	**266**	Earlston
352	Oldhamstocks	**376**	Balmerino	**245**	Chirnside	**269**	Lauder
353	Prestonkirk	**377**	Ceres	**246**	Cockburnspath	**270**	Legerwood
354	Spott	**378**	Collessie	**247**	Coldingham	**271**	Mertoun
355	Stenton	**381**	Cupar, Cults	**249**	Foulden	**567**	Heriot
356	Whittinghame	**382**	Dairsie, Kemback	**250**	Hutton	**568**	Stow
357	Athelstanford	**383**	Dunbog, Creich	**251**	Mordington	**793**	Bowden
358	Bolton	**384**	Falkland	**252**	Coldstream	**794**	Lilliesleaf
359	Garvald and Bara	**385**	Flisk	**254**	Duns, Cranshaws,	**795**	Mexton
360	Haddington	**387**	Kettle		Abbey St. Bathans	**796**	Melrose
361	Humbie	**388**	Kilmany	**255**	Eccles	**798**	St. Boswells
362	Morham	**389**	Logie	**256**	Edrom, Fogo	**799**	Caddonfoot
363	Saltoun	**390**	Moonzie, Monimail	**258**	Green law	**800**	Glashiels
364	Yester	**393**	Strathmiglo	**259**	Ladykirk	**801**	Selkirk
365	Aberlady	**417**	Cameron, Dunino	**261**	Longformacus	**802**	Ashkirk
366	Dirleton	**418**	Carnbee, Anthruster	**260**	Langton, Polwarth	**803**	Ettrick
367	North Berwick		west and east	**263**	Swinton	**804**	Kirkhope
368	Whitekirk	**419**	Crail	**264**	Whitsome	**805**	Yarrow
370	Gladsmuir	**423**	Ferry-port-On-Craig	**267**	Gordon		**Tweedale**
371	Ormiston		Forgan	**268**	Hume	**635**	Broughton, Glenholm
372	Pencaitland	**424**	Kilconquhar	**273**	Westruther		and Kilbucho
373	Tranent, Prestopans	**425**	Kilrenny		**Roxburgh**	**636**	Drumelzier
571	Inveresk	**426**	Kingsbarns	**272**	Nenthorn	**637**	Skirling
	Midlothian	**427**	Largo	**769**	Castleton	**638**	Tweedsmuire
563	Borthwick	**428**	Leuchars	**770**	Cavers	**639**	Innerleithen
564	Cranston, Crichton	**429**	Newburn and	**771**	Hawick	**640**	Traquair
566	Fala and Soutra	**431**	St. Andrews	**772**	Roberton	**642**	Newlands
569	Temple		St. Leonards	**773**	Teviothead	**643**	Linton west
570	Lasswade	**432**	St. Monance, Elie	**774**	Ancrum	**644**	Eddleston
572	Newton		and Pittenween	**776**	Crailing	**646**	Manor, Kirkud,
573	Carrington		**Kirkcaldy**	**777**	Hobkirk, Bedrule		Lyne and Stobo
574	Cockpen	**403**	Achterderran	**778**	Jedburgh	**647**	Peebles
575	Dalkieth	**404**	Achtertool	**779**	Minto		
576	Newbattle	**408**	Kennoway	**780**	Oxnam		
577	Glencorse	**409**	Kinghorn, Burntisland	**781**	Southdean		
578	Penicuik	**410**	Kinglessie	**782**	Eckford		
	City of Edinburgh	**411**	Kirkcaldy and Dysart	**783**	Ednam		
558	Currie	**412**	Leslie	**784**	Hownam		
559	Kirkliston	**413**	Markinch	**785**	Kelso		
560	Ratho	**415**	Scoonie, Wemyss	**786**	Linton		
581	City parish of Edinburgh		**Dunfermline**	**787**	Makerstoun		
844	Dalmeny	**394**	Aberdour	**788**	Morebattle		
	West Lothian	**395**	Carnock	**789**	Smailhom		
561	Kirknewton	**396**	Culross	**790**	Sprouston		
562	Midcalder	**397**	Dalgety	**791**	Stichill		
585	Westcalder	**398**	Dunfermline	**792**	Yetholm		
842	Linlithgow	**399**	Inverkeithing	**797**	Roxburgh		
843	Abercorn	**400**	Saline				
846	Bathgate	**401**	Torryburn				
847	Torphichen	**402**	Tulliallan				
848	Ecclesmachan	**405**	Ballingry				
849	Uphall	**406**	Beath				
850	Livingston						
851	Whitburn						

Appendix 3.1 QUESTIONNAIRE FOR FIELD SURVEY

1. Parish in which farm is located ____________________________
2. Status of the respondent (please tick) Owner Tenant Manager Other _______
3. Tenure (please tick) Wholly owned _____ Wholly Rented _____ Part owned / rented ____
4. Total area of the farm ______________hectares
5. Number of separate parcels of land ____________

The Farm Business

6. Type of farm (e. g. dairy, cash crops) ________________________
7. Is the farm ? full-time _______ or part-time ________ or a hobby __________
8. Is the farm ? a family business ___________ a corporate business _________
9. Has the farm changed in size since 1973 ? Increase _______ ha Decrease _______ ha No change ______
10. **Does the farm produce income from any of the following ?** (please tick boxes) :

Woodland		Shooting	
Fishing		Horse riding	
Other sports		Farm Accommodation	
Pick-Your-Own		Farm Shop	

11. **Present area of each crop** **Has the area under this crop been increased or decreased since 1973 ?**

	Hectares	Increased	Decreased	No change
Wheat				
Barley				
Oats				
Oilseed Rape				
Turnips / Swedes				
Potatoes				
Vegetables				
Fruit				
Fallow				
Woodland				
Others				

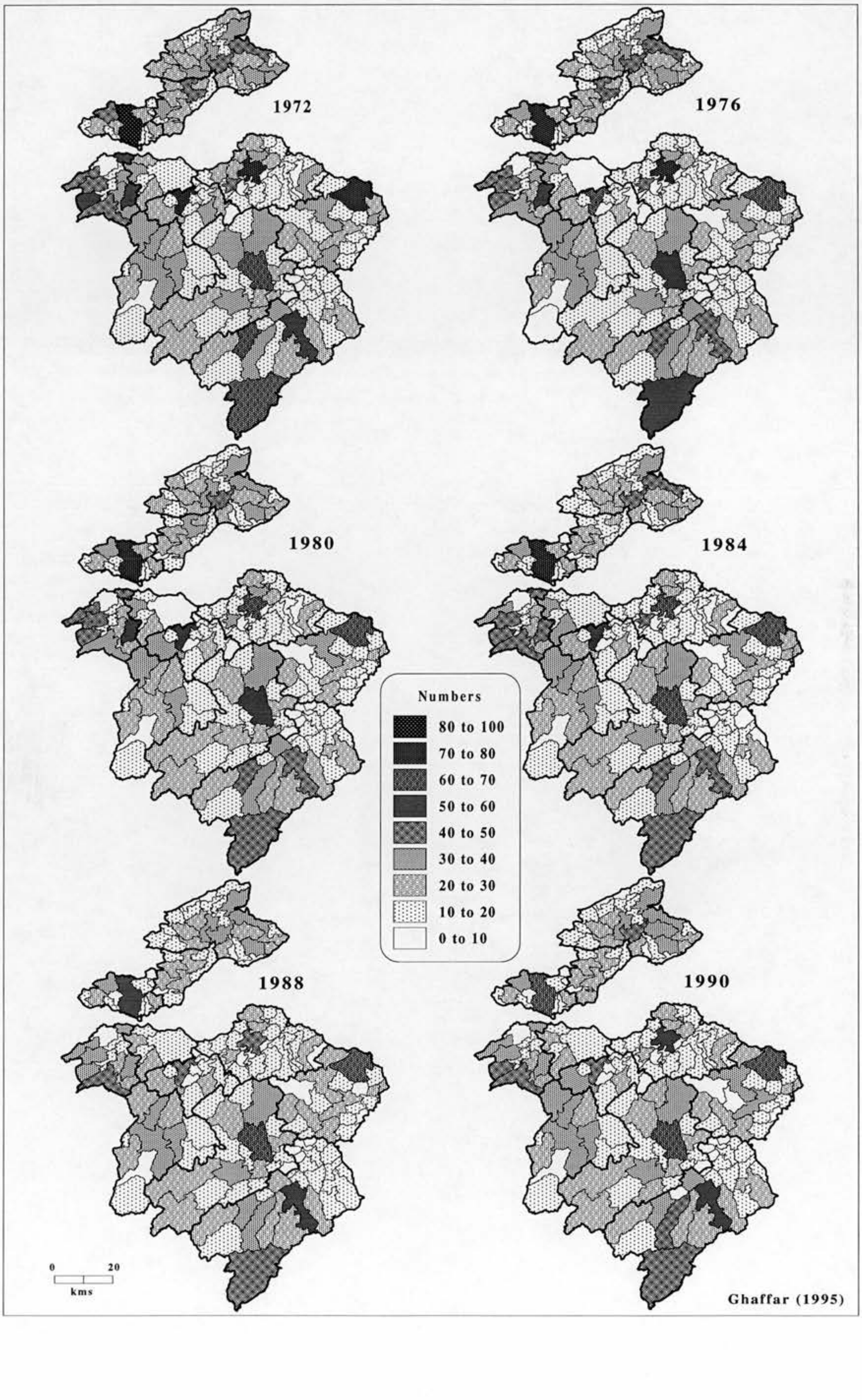
12. **Present numbers of livestock** **Have the numbers increased or decreased since 1973 ?**

	Numbers	Increased	Decreased	No change
Dairy Cattle				
Beef Cattle for fattening				
Beef Cattle for rearing				
Sheep				
Pigs				
Poultry				

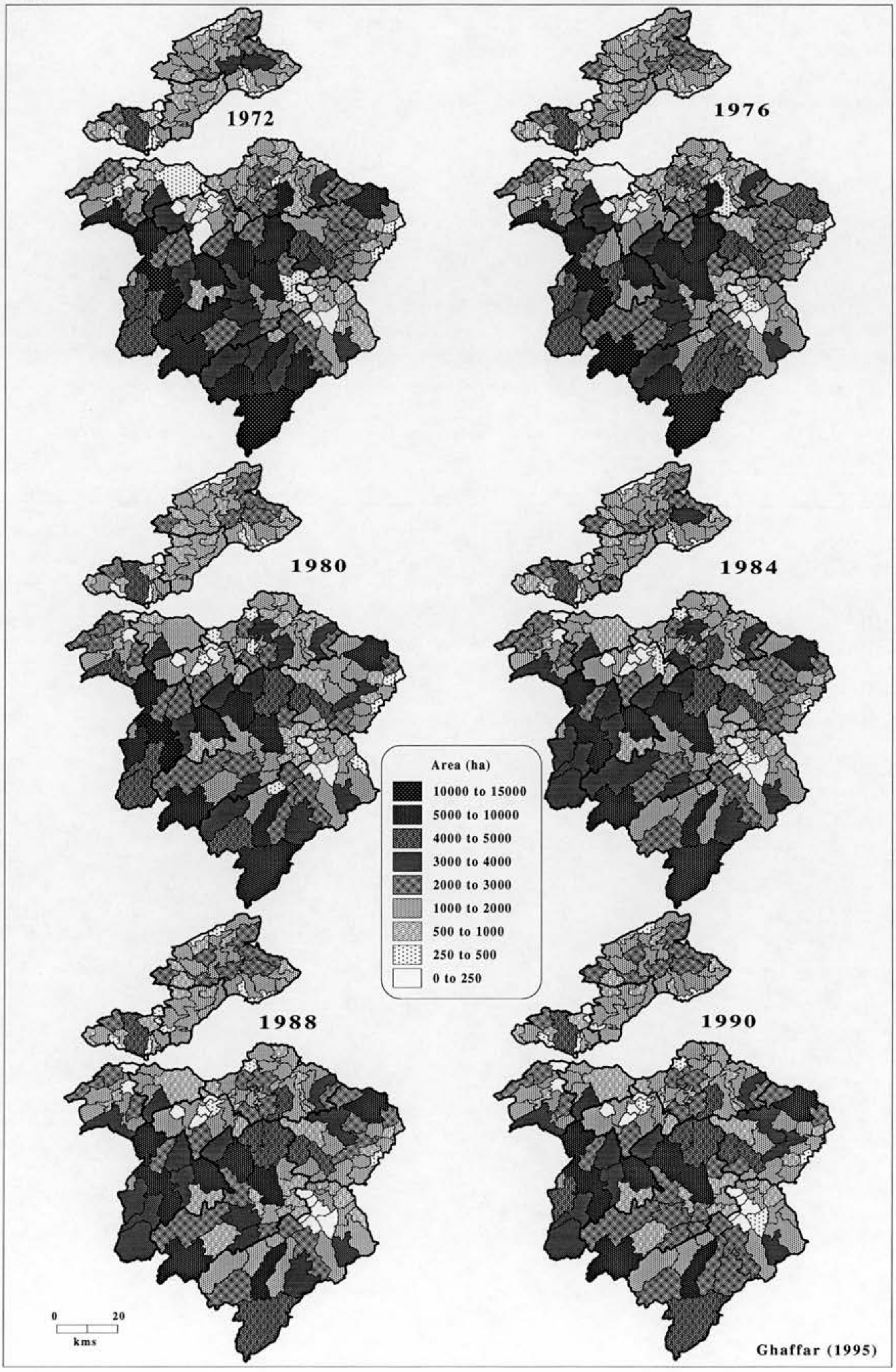
13. **Please give details of your labour force including you and your family**

	Male	Female
Total permanent labour		
a. Family members (including yourself)		
b. Others		
c. Full time (inc. a & b)		
d. Part time (inc. a & b)		
Casual / seasonal workers (exc. a, b, c & d)		

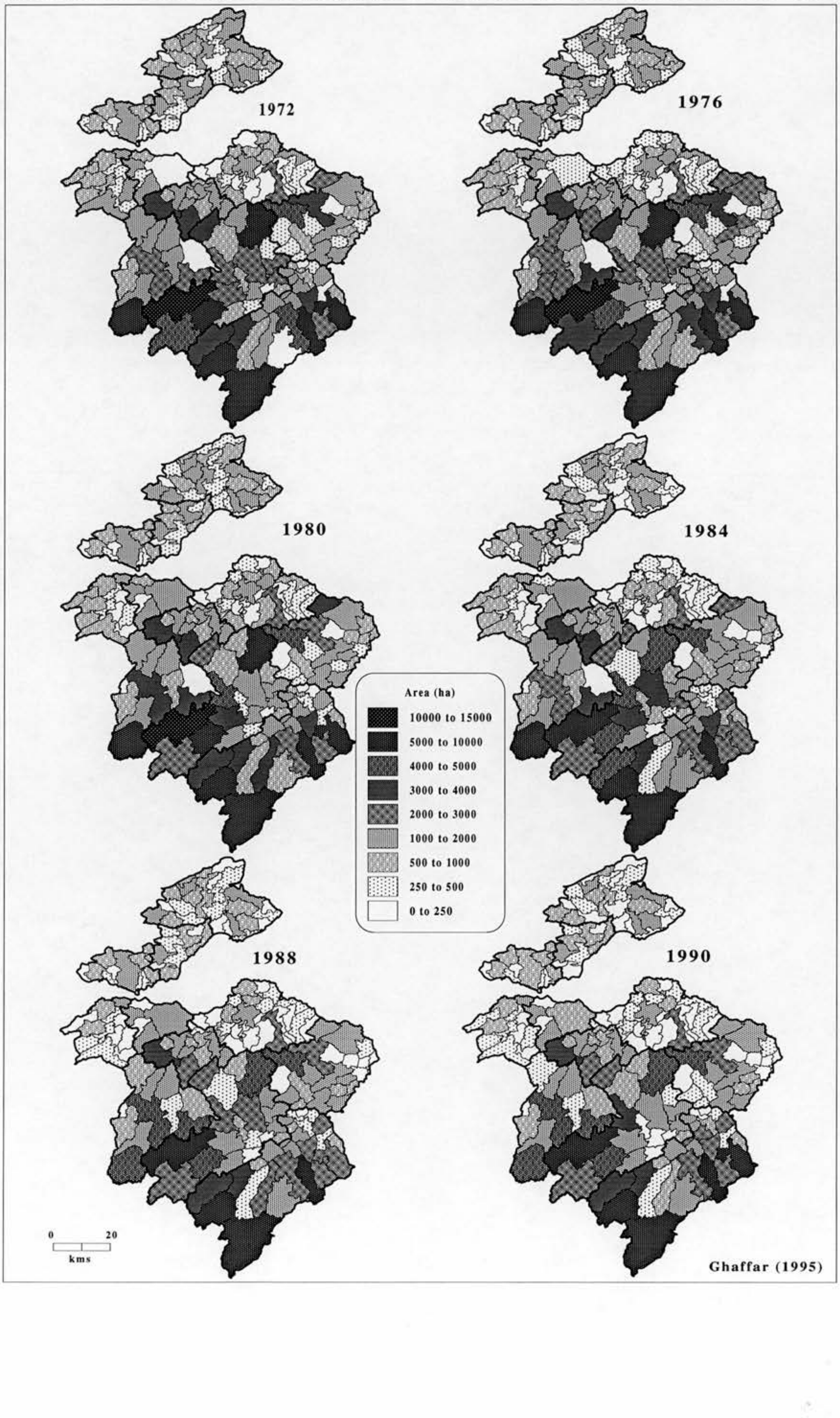
Appendix 4.1 Farm holdings in South East Scotland, 1972 - 1990



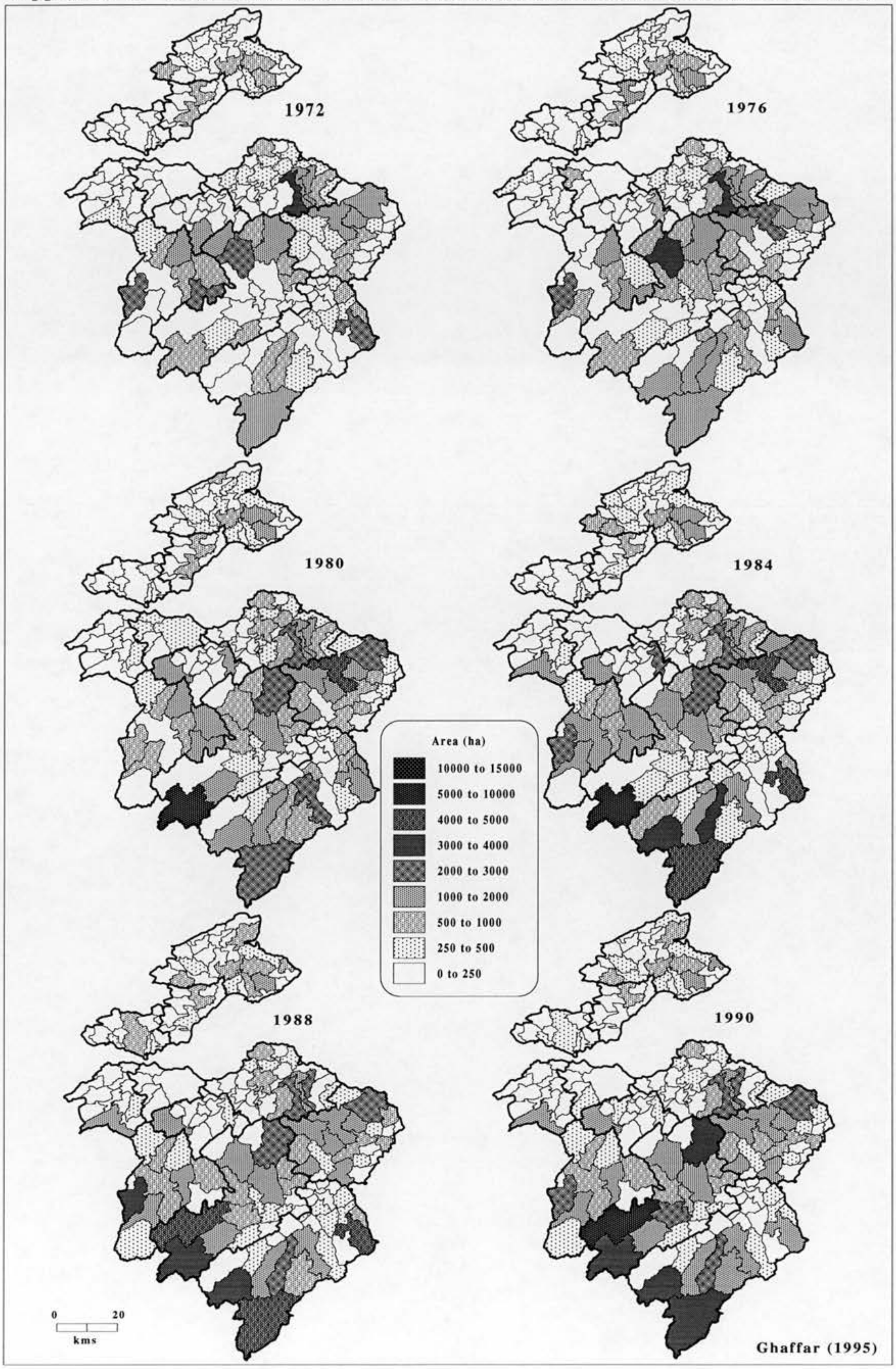
Appendix 4.2 Area owned by farmers in South East Scotland, 1972 - 1990



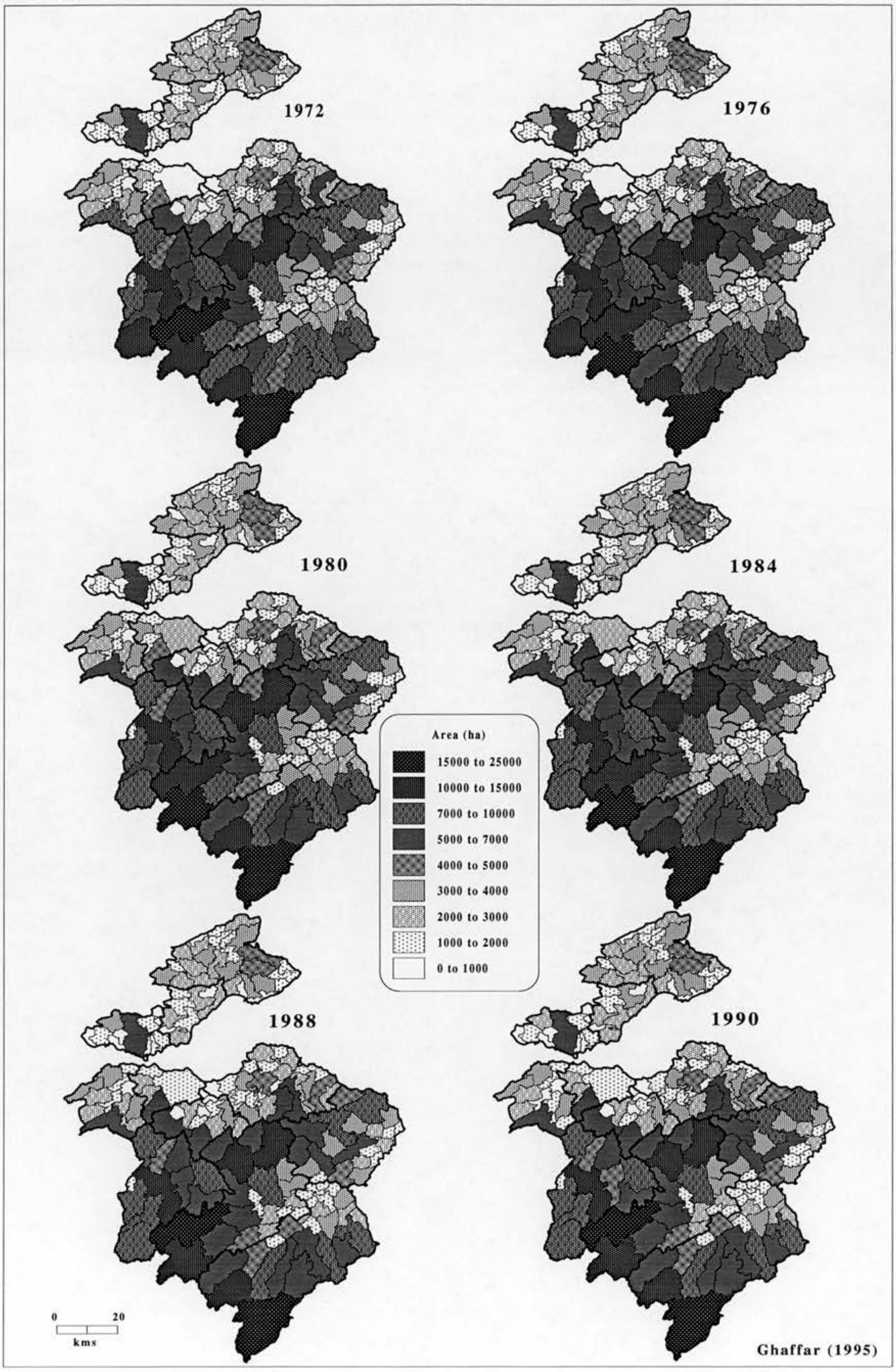
Appendix 4.3 Area rented from outside concerns in South East Scotland, 1972 - 1990



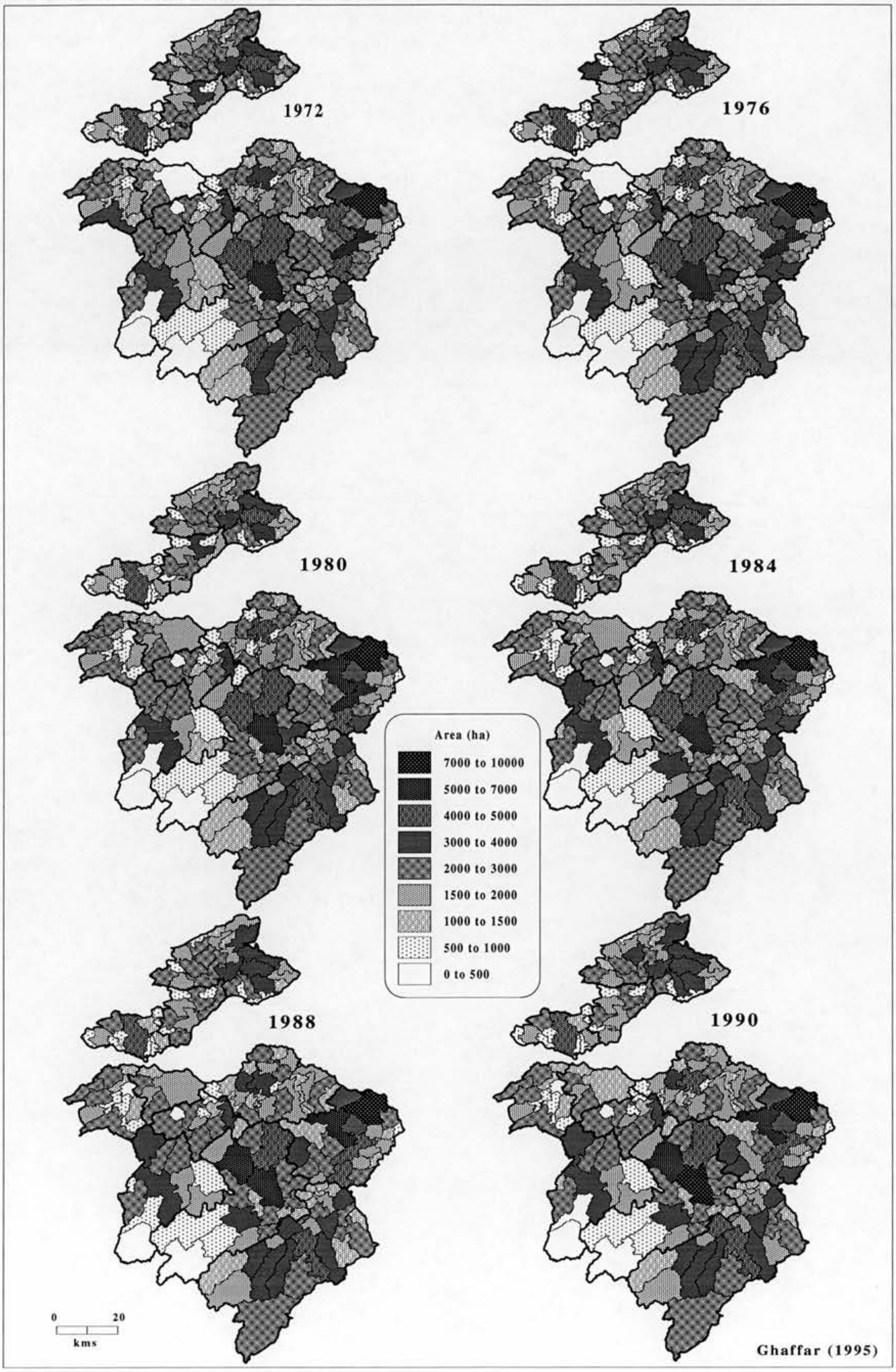
Appendix 4.4 Area rented from near relatives in South East Scotland, 1972 - 1990



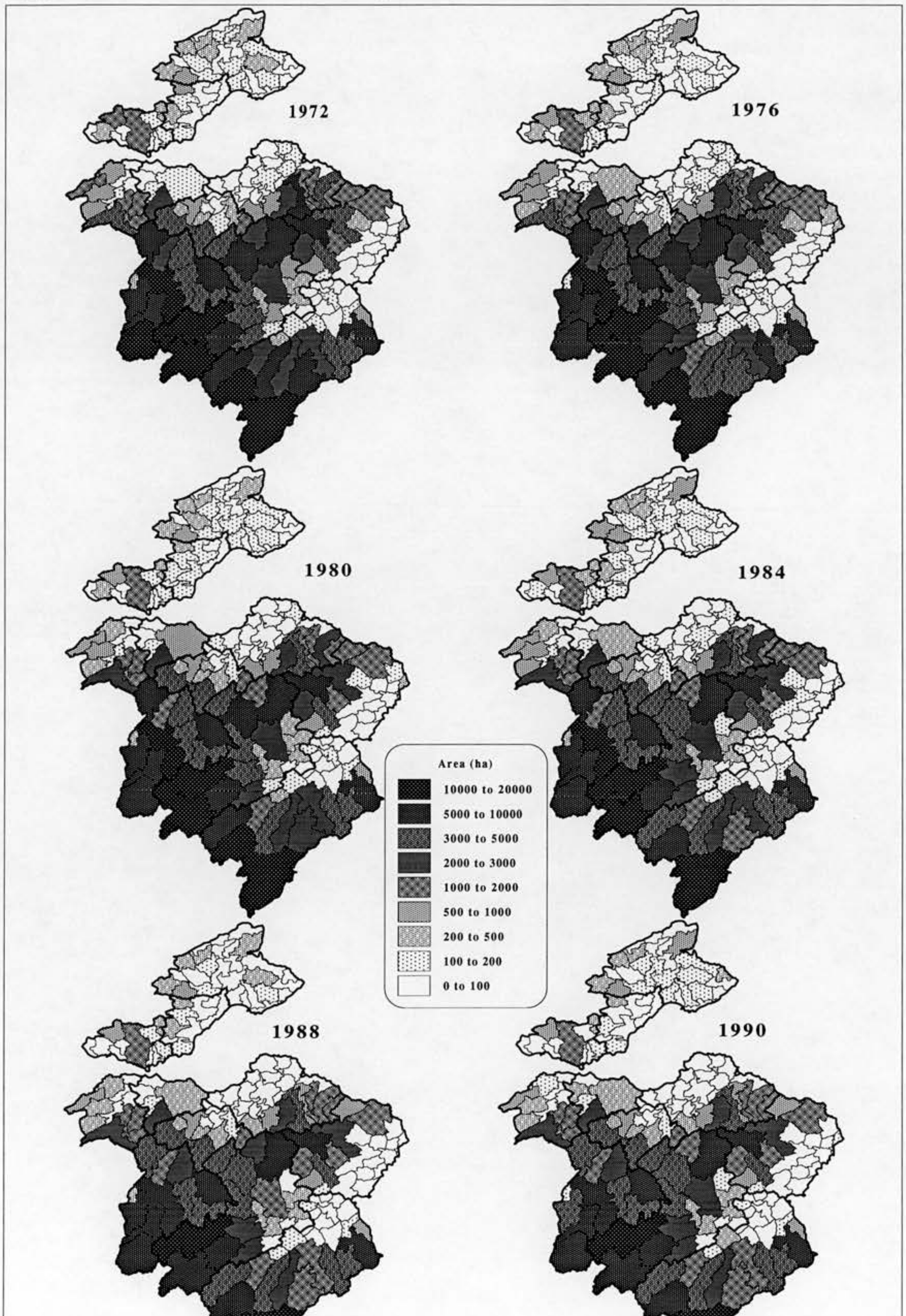
Appendix 4.5 Total area of land in South East Scotland, 1972 - 1990



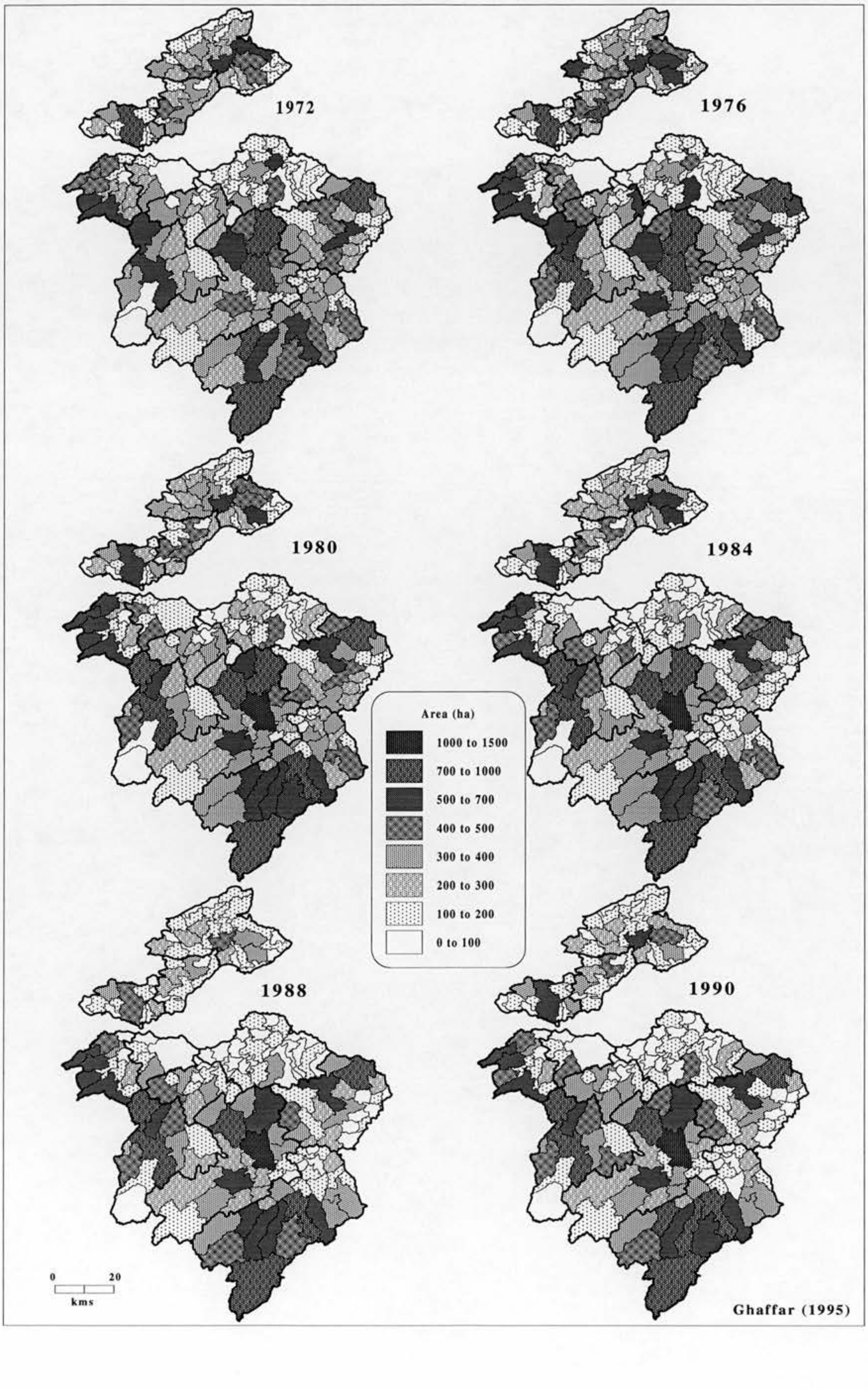
Appendix 4.6 Agricultural land in South East Scotland, 1972 - 1990



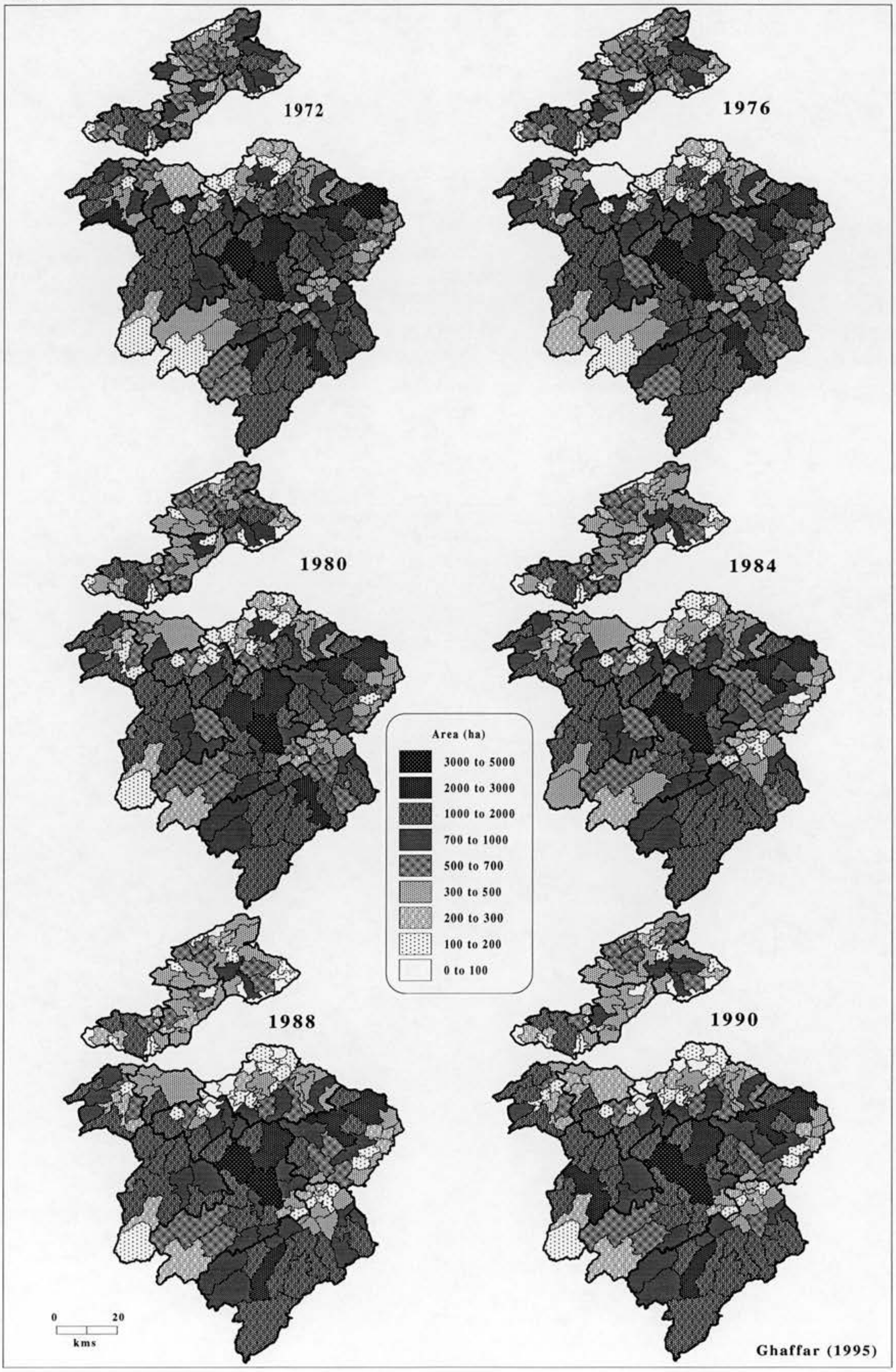
Appendix 4.7 Area under rough grazing in South East Scotland, 1972 - 1990



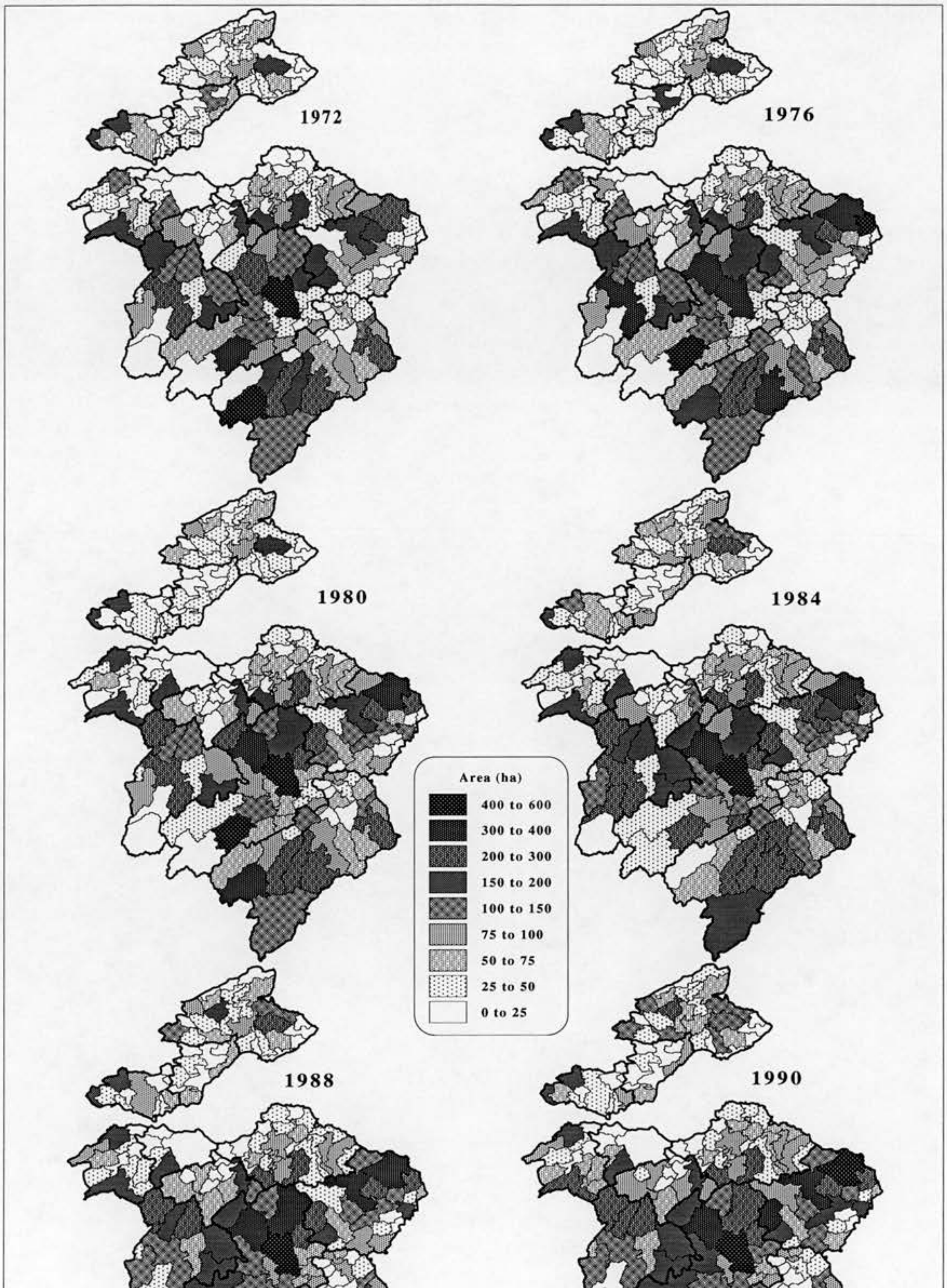
Appendix 4.8 Area under grass for mowing in South East Scotland, 1972 - 1990



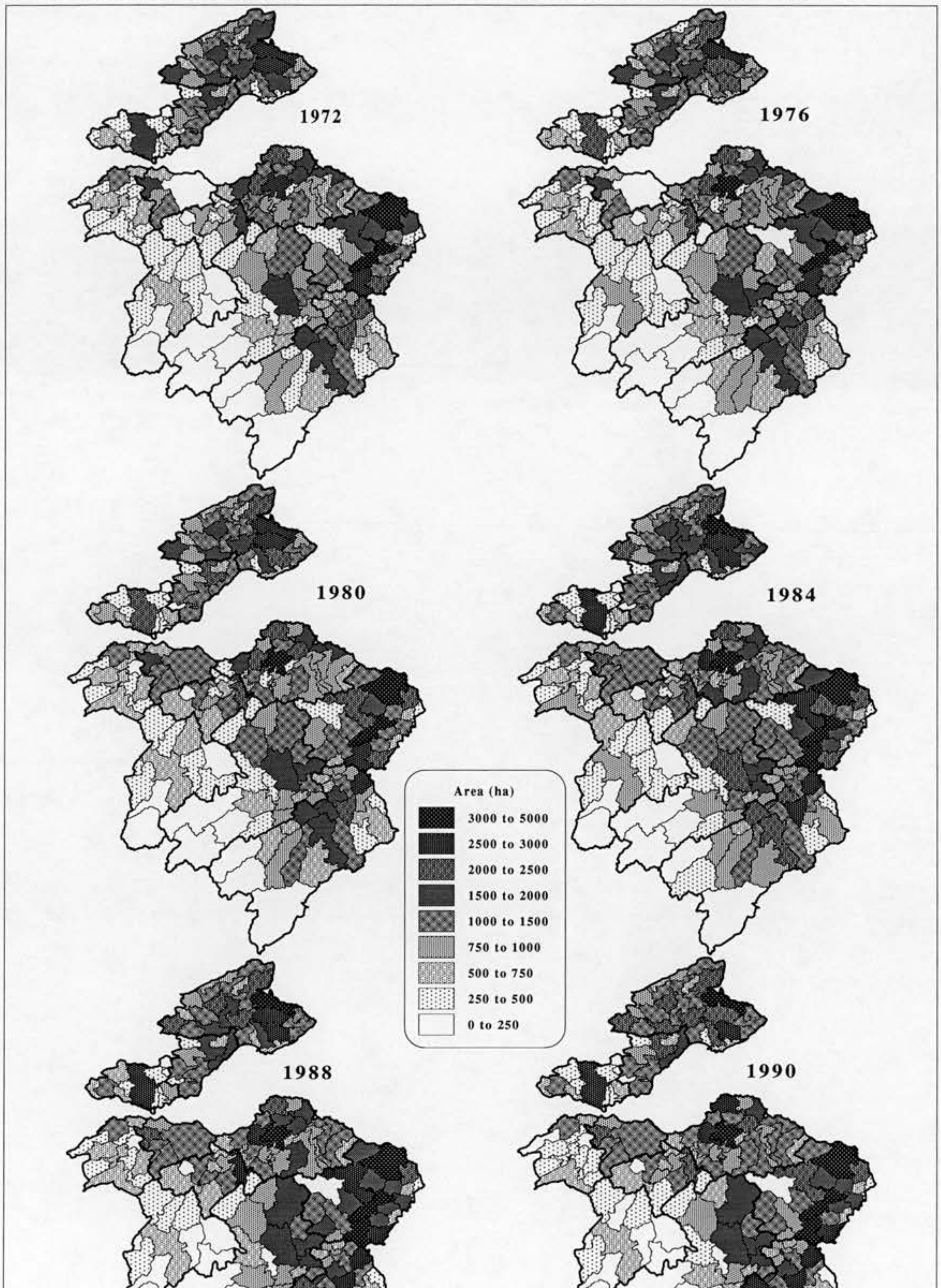
Appendix 4.9 Area under grass not for mowing in South East Scotland, 1972 - 1990



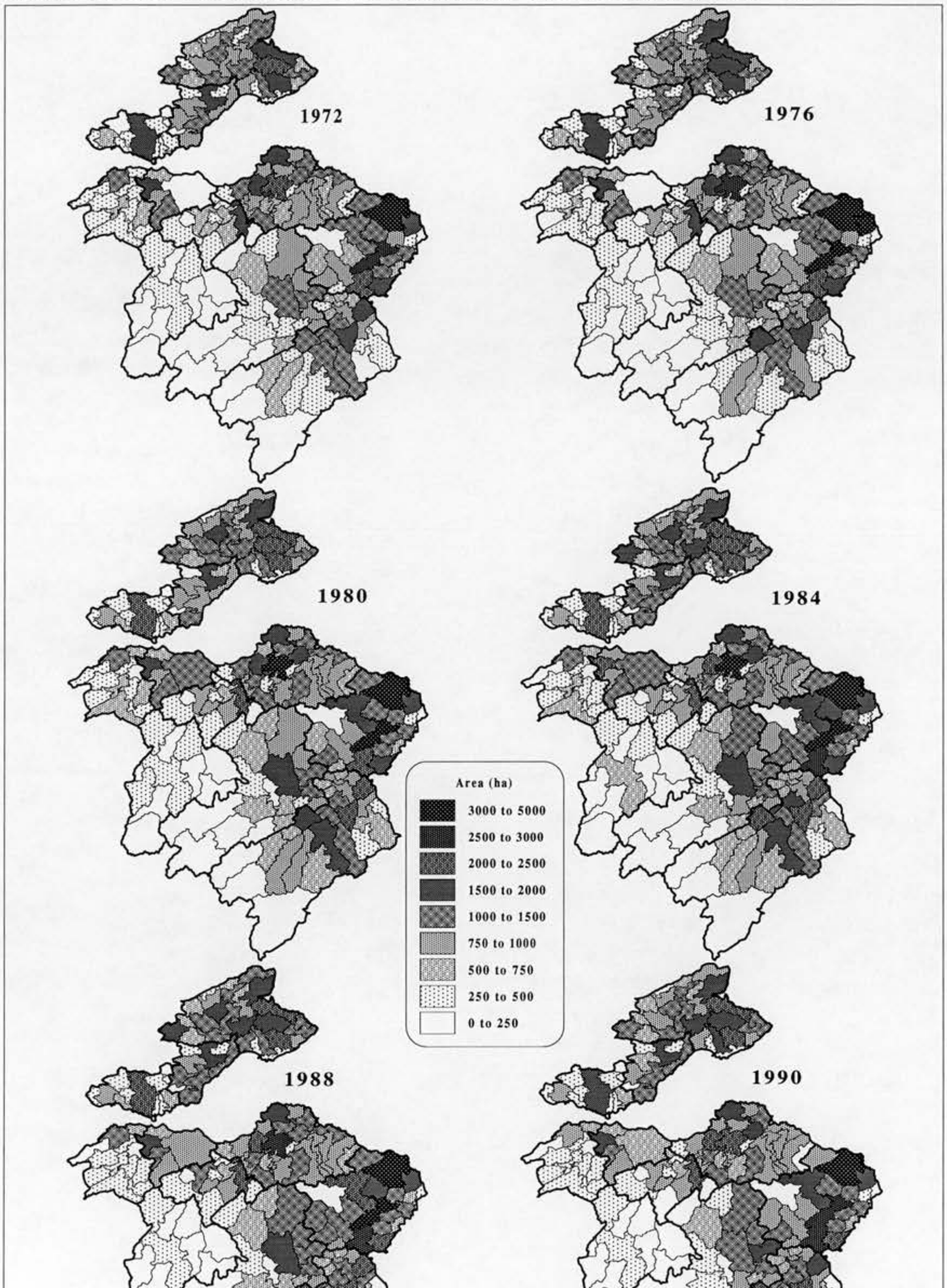
Appendix 4.10 Area under farm woodland in South East Scotland, 1972 - 1990



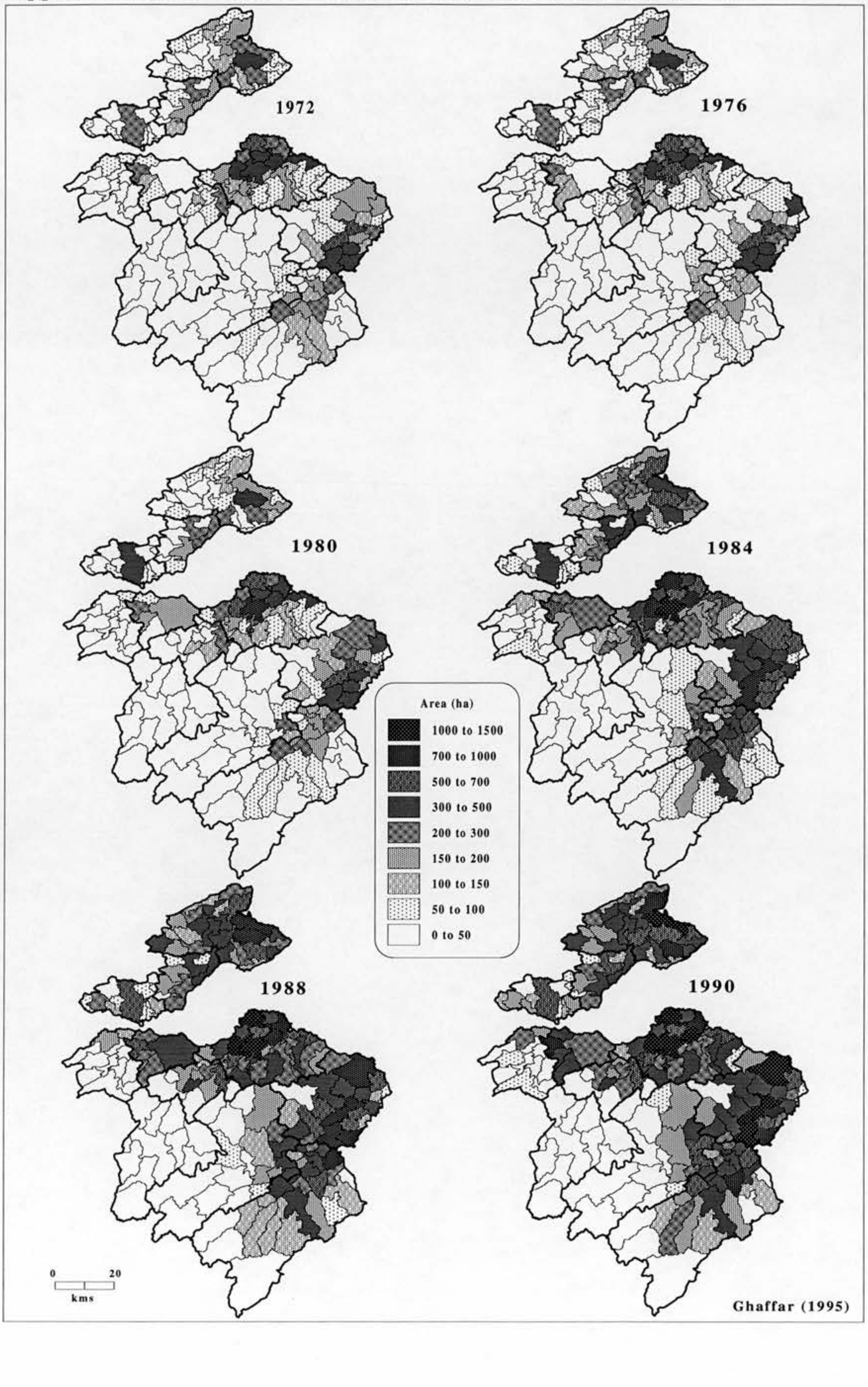
Appendix 4.11 Area under tillage in South East Scotland, 1972 - 1990



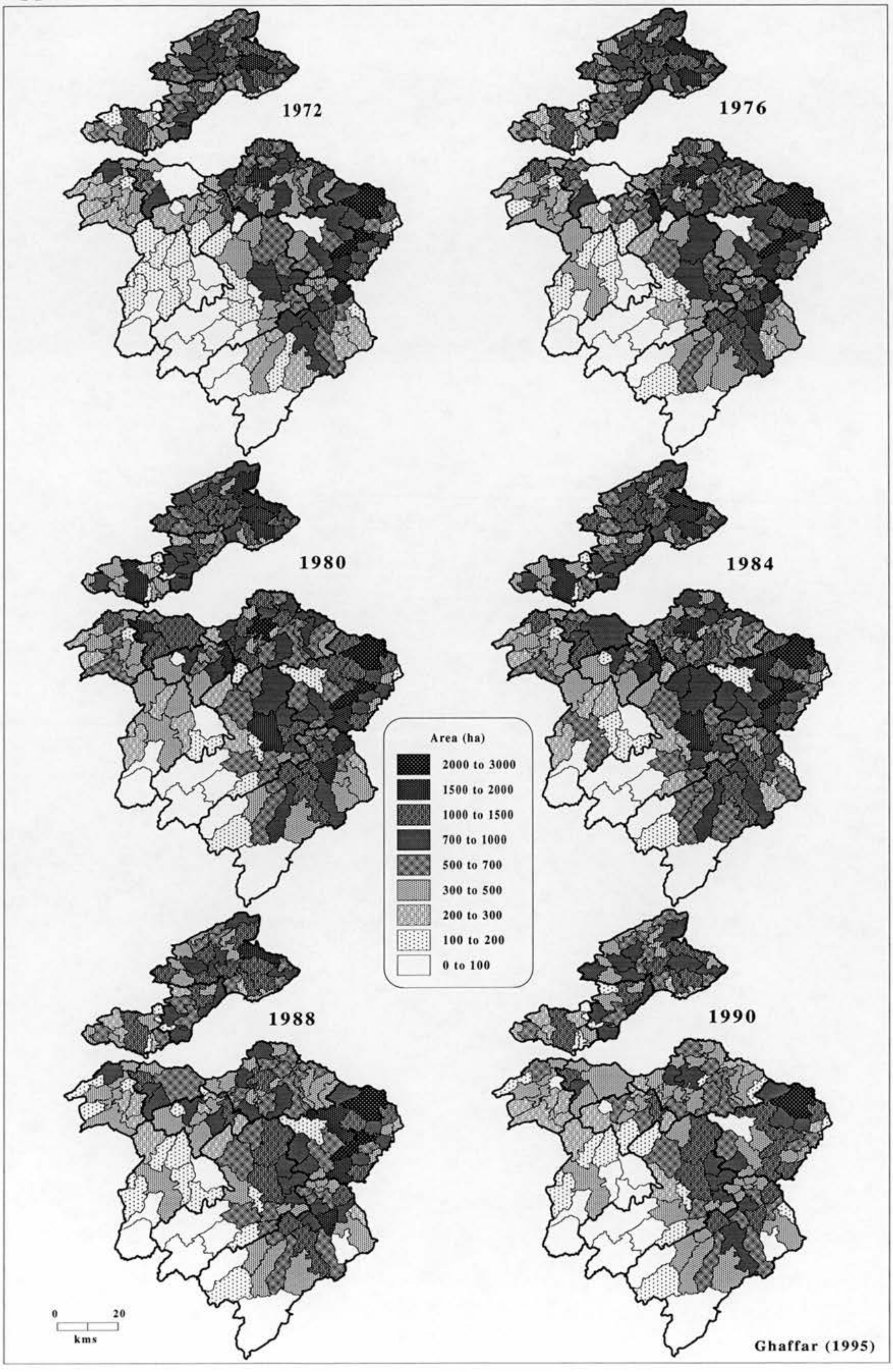
Appendix 4.12 Area under cereals in South East Scotland, 1972 - 1990



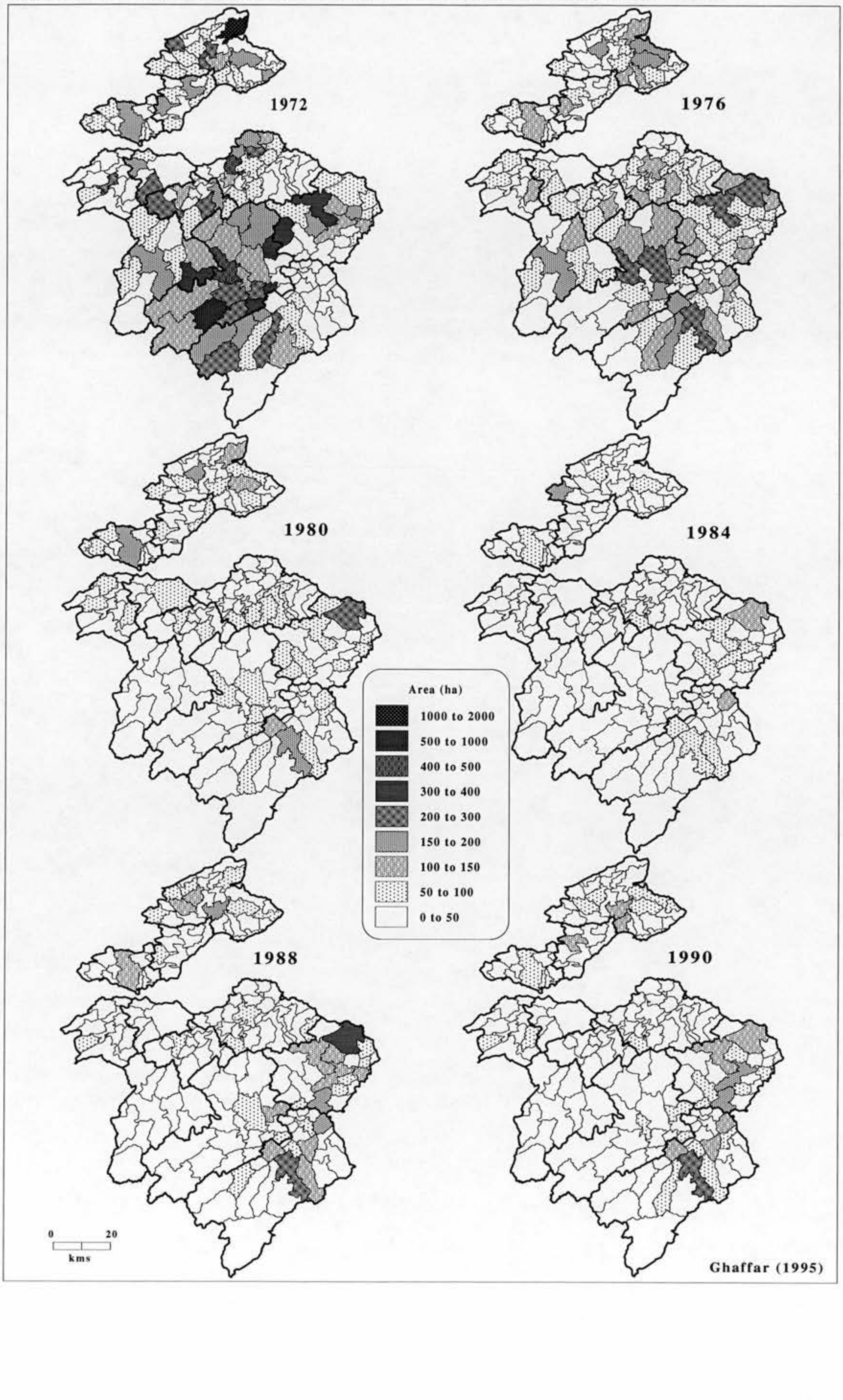
Appendix 4.13 Area under wheat in South East Scotland, 1972 - 1990



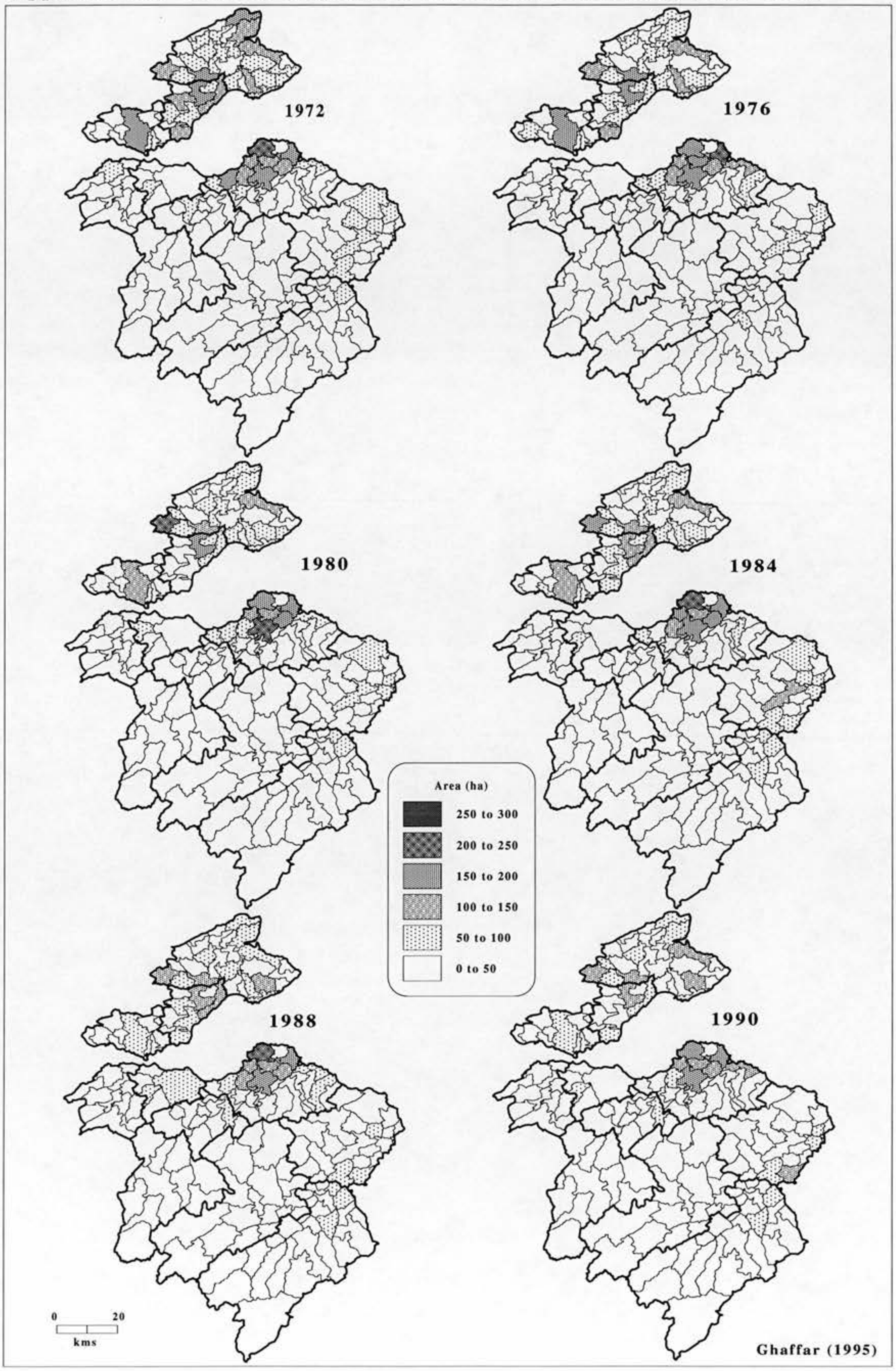
Appendix 4.14 Area under barley in South East Scotland, 1972 - 1990



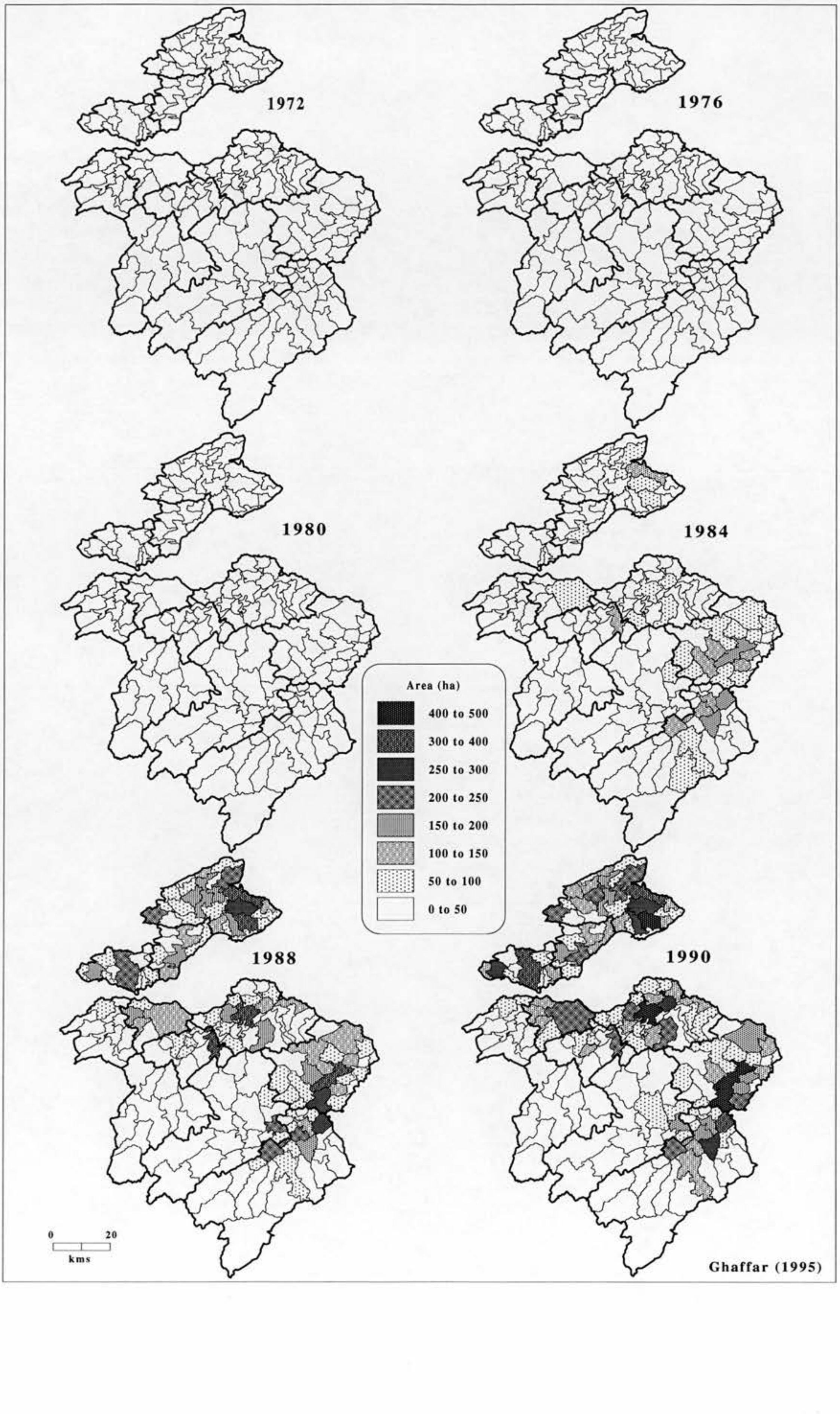
Appendix 4.15 Area under oats in South East Scotland, 1972 - 1990



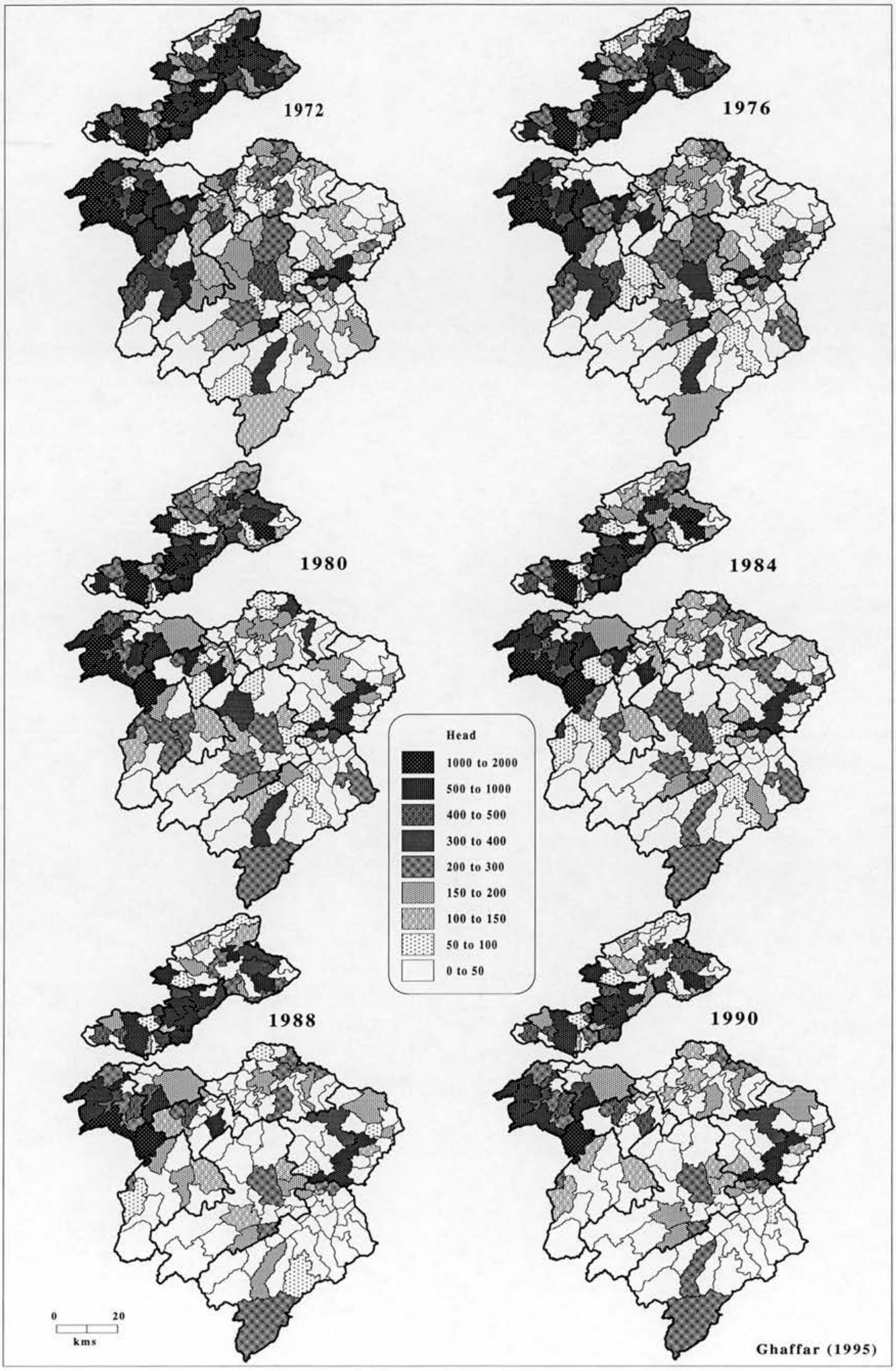
Appendix 4.16 Area under potatoes in South East Scotland, 1972 - 1990



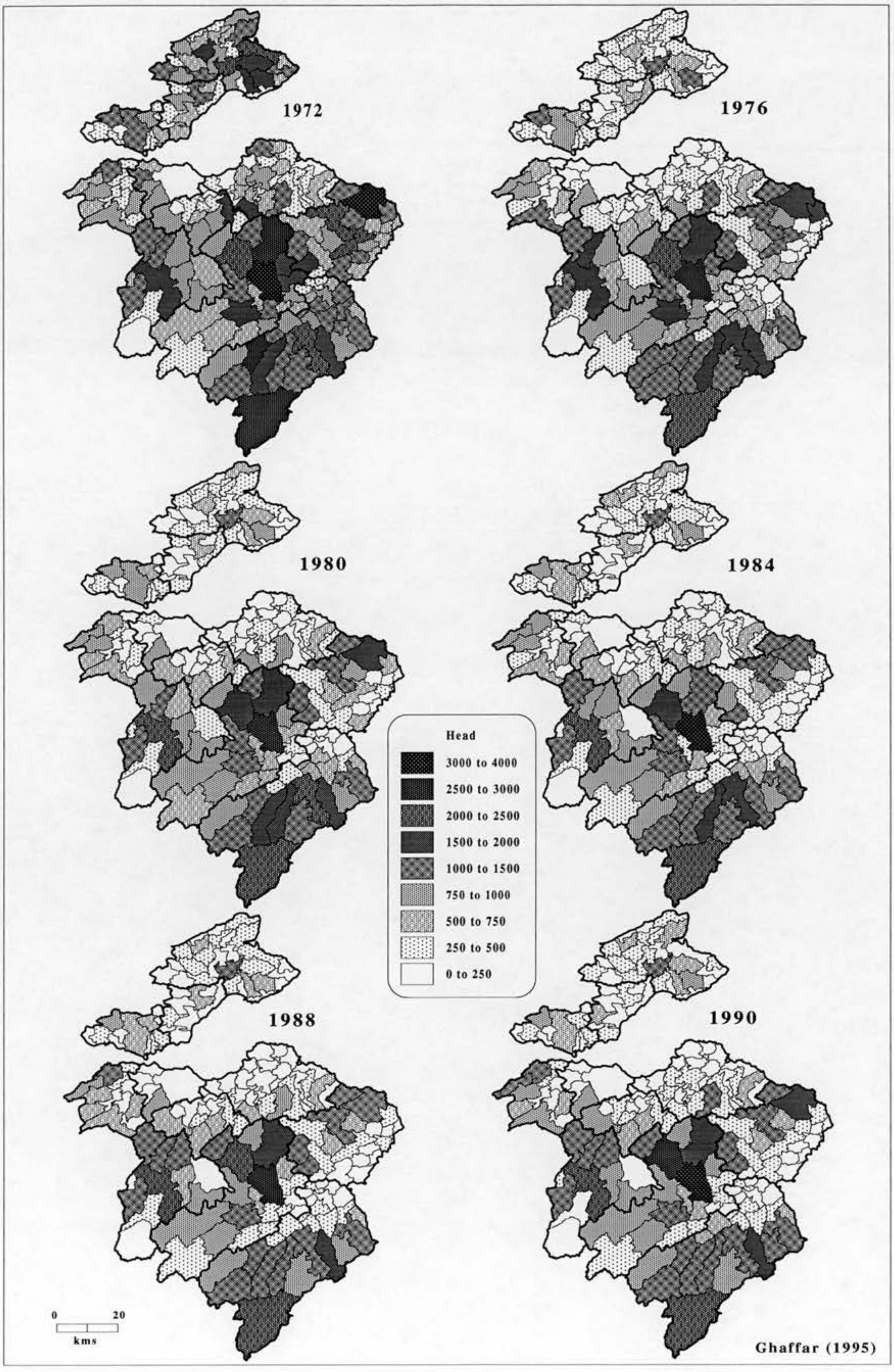
Appendix 4.17 Area under oilseed rape in South East Scotland, 1972 - 1990



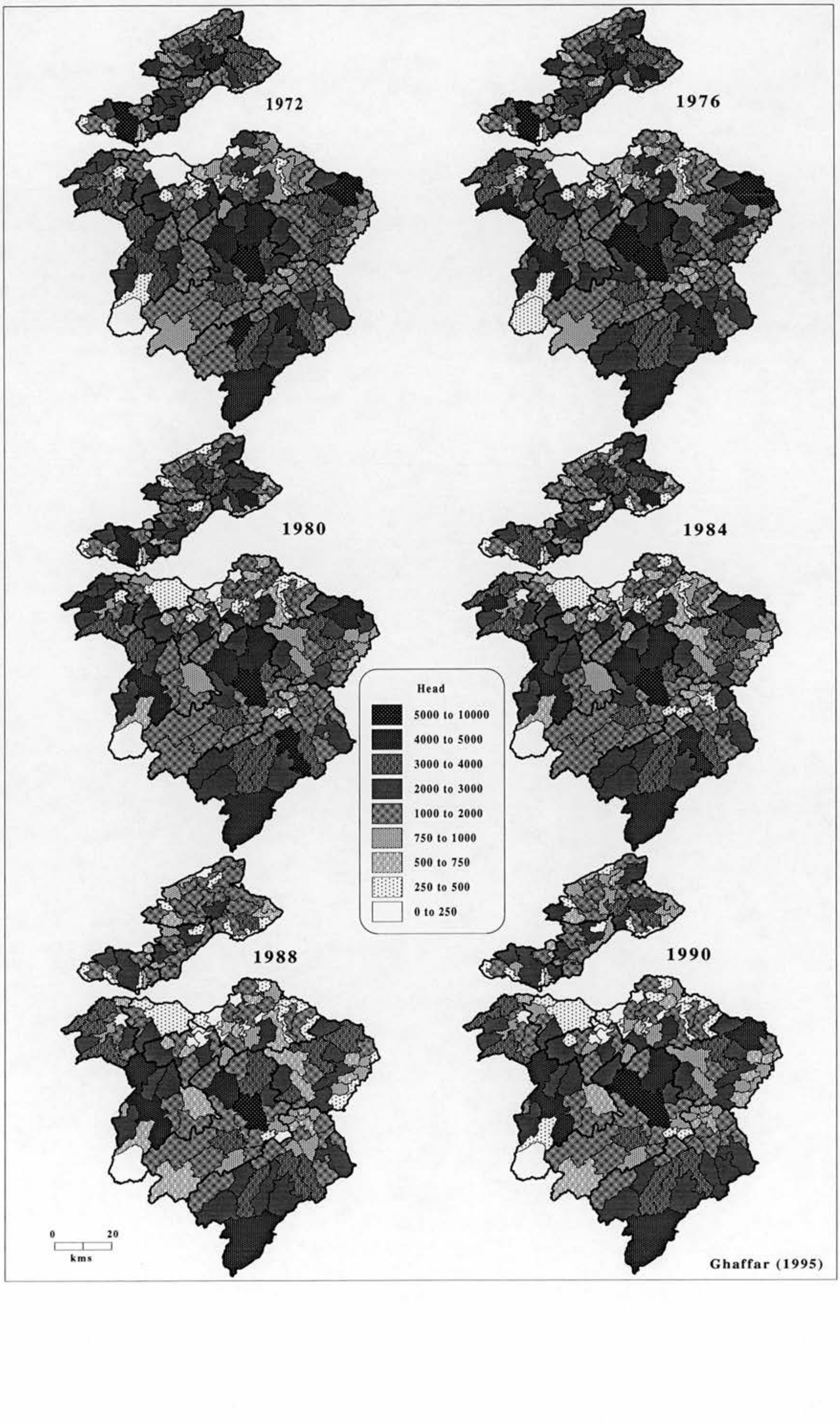
Appendix 4.18 Dairy cattle production in South East Scotland, 1972 - 1990



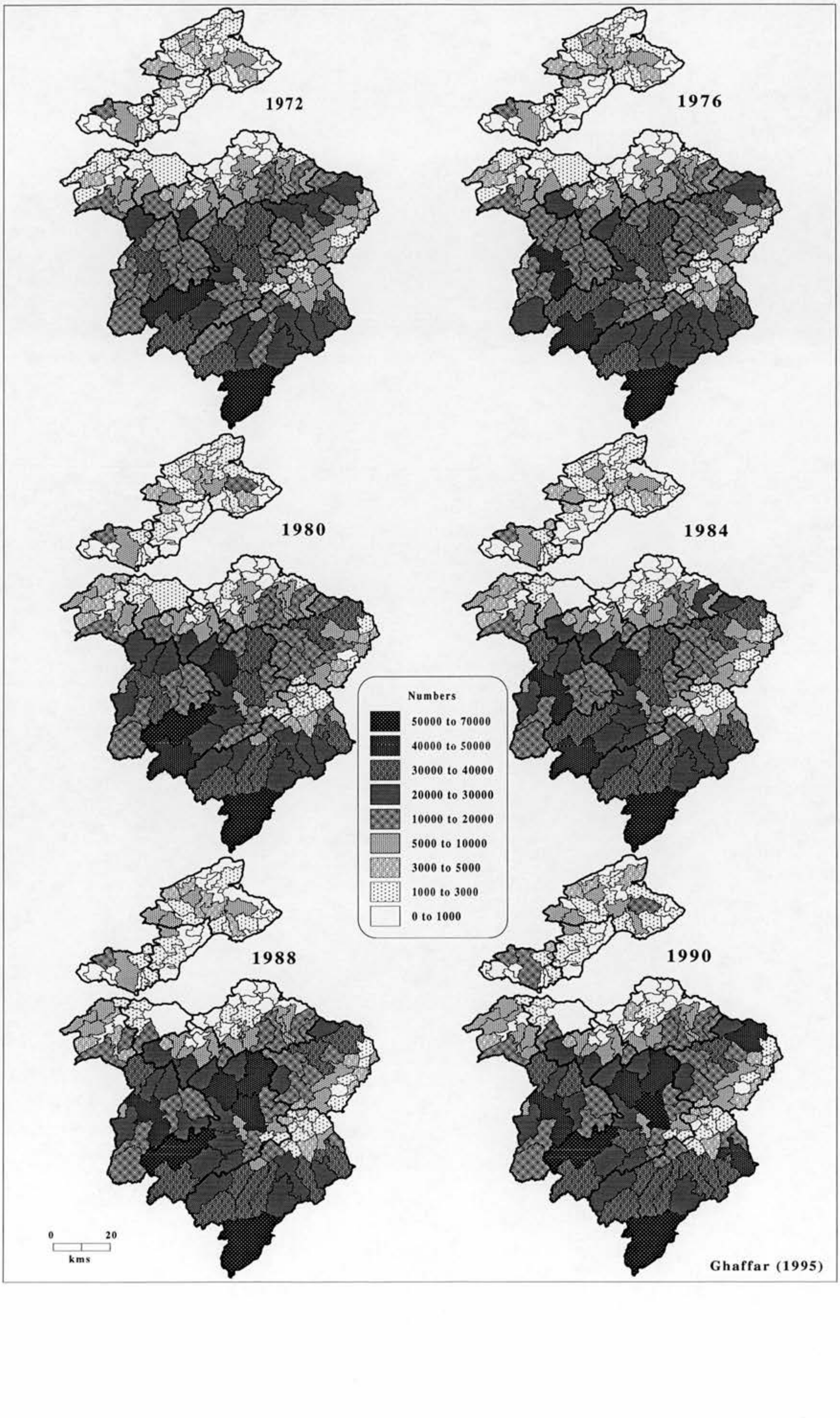
Appendix 4.19 Beef cattle production in South East Scotland, 1972 - 1990



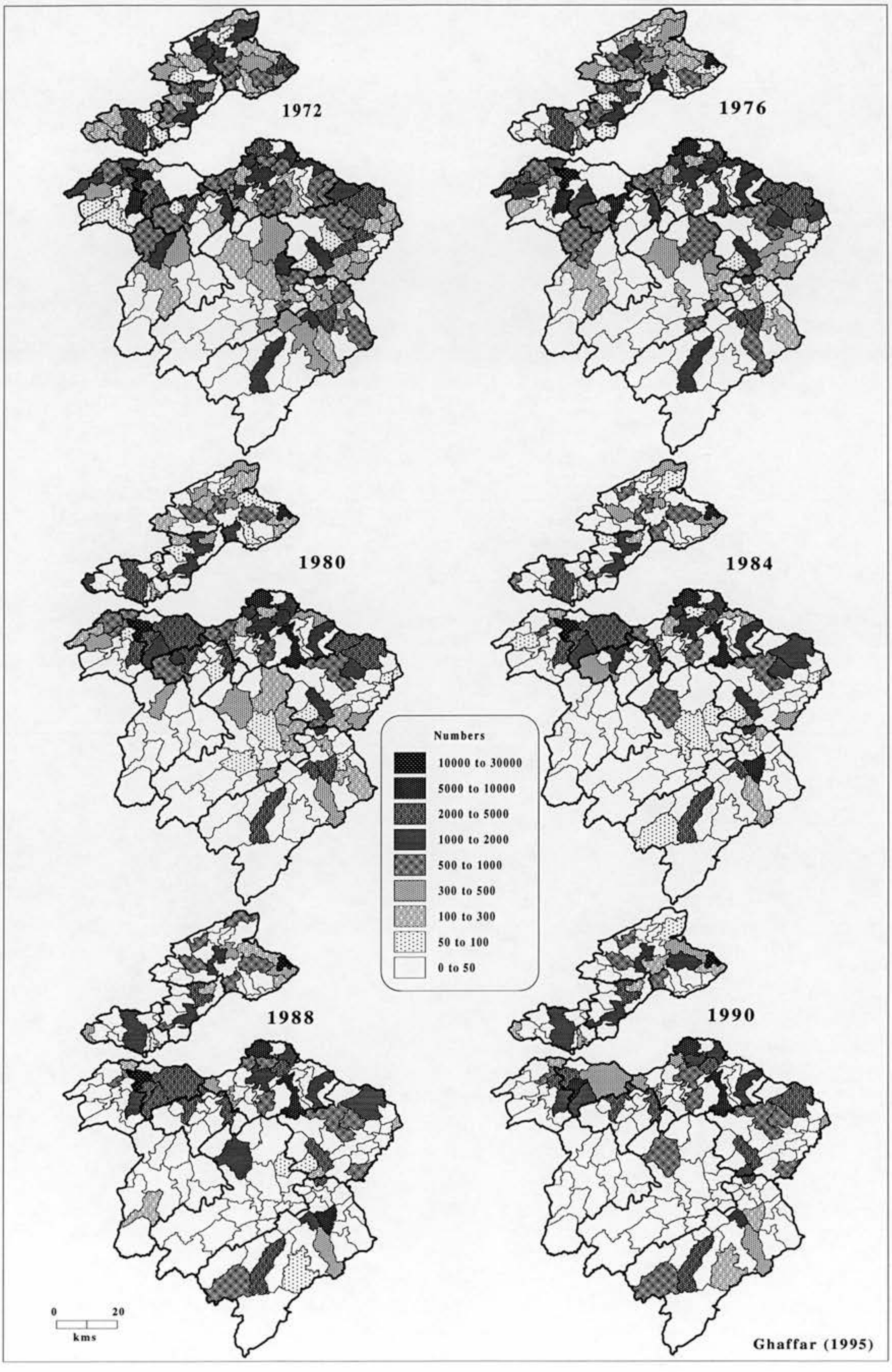
Appendix 4.20 Cattle (all types) production in South East Scotland, 1972 - 1990



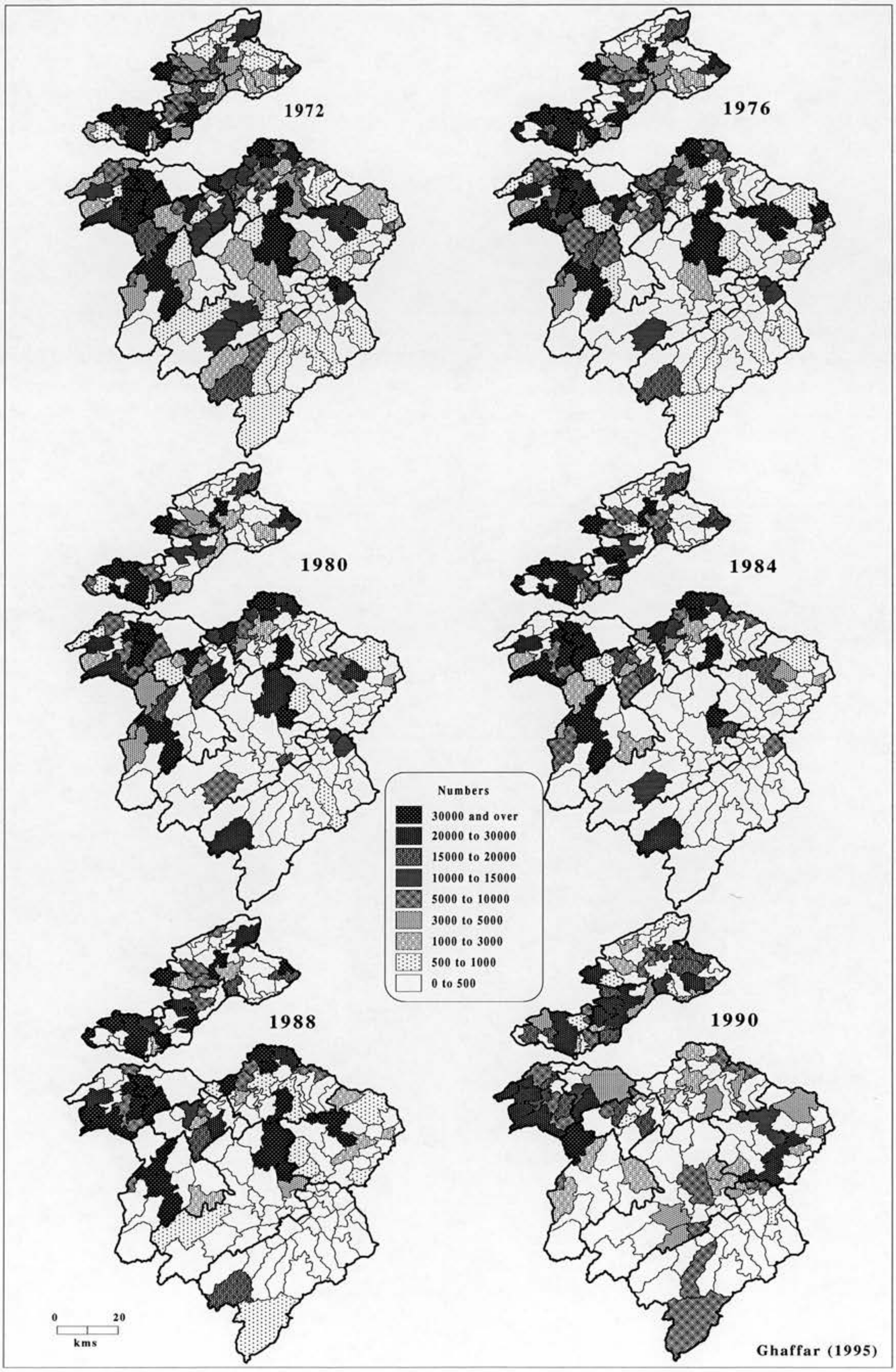
Appendix 4.21 Sheep production in South East Scotland, 1972 - 1990



Appendix 4.22 Pig production in South East Scotland, 1972 - 1990



Appendix 4.23 Poultry production in South East Scotland, 1972 - 1990



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